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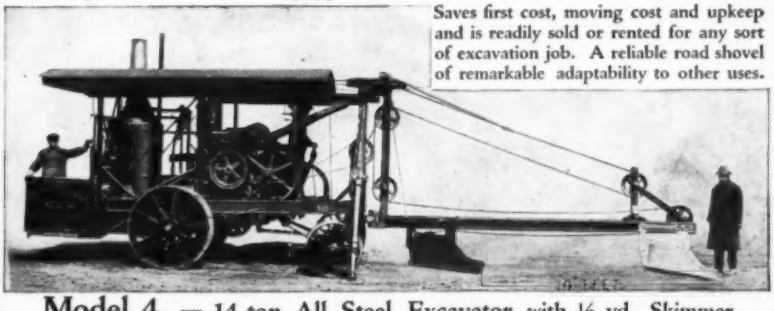

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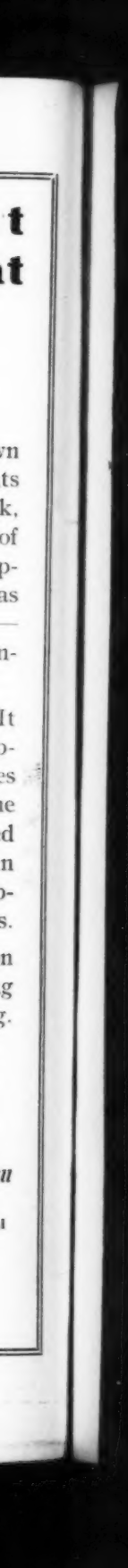

Where to Purchase

A comprehensive Directory of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers, water-works superintendents, municipal and county engineering departments, street and highway officials, city managers, etc., and public officials who may desire to secure catalogs or prices on construction equipment. Where the name of a manufacturer is preceded by a star (*) it indicates that the user of the directory may secure further information by referring to the manufacturer's advertisement in this issue. The index to advertisers will be found on page facing the inside back cover.

ACETYLENE
Linde Air Products Co., New York.
Prest-O-Lite Co., Inc., New York.

ACETYLENE APPARATUS
Davis-Bournonville Co., Jersey City, N. J.
Oxweld Acetylene Co., Newark, N. J.

ADDING MACHINES. (See Calculating Machines.)

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*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Nordberg Mfg. Co., Milwaukee, Wis.
Cement-Gun Co., Inc., Cornwell Hts., Pa.
Chicago Pneumatic Tool Co., New York, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
De La Vergne Machine Co., N. Y. C.
Gardner Governor Co., Quincy, Ill.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Indiana Air Pump Co., Indianapolis, Ind.
Ingersoll-Rand Co., N. Y. C.
Mundie Mfg. Co., Peru, Ill.
Norwalk Iron Works Co., South Norwalk, Conn.
Schramm & Son, Inc., Chris. D., West Chester, Pa.
Stratton & Bragg Co., Petersburg, Va.
Sullivan Mchy. Co., Chicago, Ill.
United Iron Works, Kansas City, Mo.
Westinghouse Trac. Brake Co., Wilmerding, Pa.
Worthington Pump & Mchy. Corp., N. Y. C.

ARC LAMPS
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ARCHITECTURAL IRON WORK
Chesapeake Iron Works, Baltimore, Md.
Dietrich Bros., Baltimore, Md.
Hirsch Rolling Mill Co., St. Louis, Mo.
Snead Arch Iron Works, Louisville, Ky.
Stewart Iron Works Co., Cincinnati, Ohio

ARMORED CONCRETE PAVEMENTS
*Truscon Steel Co., Youngstown, Ohio.
Concrete Steel Co., New York.

ARTESIAN WELL DRILLS AND PUMPS
*Am. Well Works, Aurora, Ill.

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Dominion Asbestos & Rubber Corp., N. Y. C.
Keasbey & Mattison Co., Ambler, Pa.

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*Otterson Auto Eductor Co., Springfield, O.
*Bay City Dredge Wks., Bay City, Mich.
*Byers Mach. Co., Ravenna, Ohio.
*International Motor Co., New York.
*Weller Mfg. Co., Chicago, Ill.
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Gifford-Wood Co., Hudson, N. Y.
Green Eng. Co., East Chicago, Ind.
Guarantee Constr. Co., N. Y. C.
Haiss Mfg. Co., Geo., New York.
Jeffrey Mfg. Co., Columbus, Ohio.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Eng. Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Portable Mchy. Co., Passaic, N. J.
Robins Conv. Belt Co., N. Y. C.
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*Barrett Co., New York.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
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Gulf Refining Co., Pittsburgh, Pa.
Headley Good Roads Co., Philadelphia, Pa.
New Orleans Refining Co., New Orleans, La.
Sinclair Ref. Co., Chicago, Ill.
Standard Oil Co. of Calif., San Francisco, Cal.
Standard Oil Co. of La., New Orleans, La.
Standard Oil Co. of N. J., Newark, N. J.
Standard Oil Co. of N. Y., New York.
Texas Co., N. Y. C.
U. S. Asphalt Refining Co., New York.
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Ingersoll-Rand Co., New York.

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East Iron & Machine Co., Lima, Ohio.
Hetherington & Berner, Indianapolis, Ind.
Warren Bros. Co., Boston, Mass.

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*Equitable Asphalt Maint. Co., Kansas City, Mo.
Hauck Mfg. Co., Brooklyn, N. Y.

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*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Weller Mfg. Co., Chicago, Ill.
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Austin Machinery Corp'n, Chicago, Ill.
Constr. Mchy. Co., Waterloo, Ia.
Oshkosh Mfg. Co., Oshkosh, Wis.
Parsons Co., Newton, Ia.

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*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Machinery Co., Dunellen, N. J.
Concrete Steel Co., New York.
Electric Welding Co., Pittsburgh, Pa.
Hinman & Co., D. A., Sandwich, Ill.

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Concrete Steel Co., N. Y. C.
Universal Form Clamp Co., Chicago, Ill.

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Bethlehem Steel Co., Bethlehem, Pa.
Carbon Steel Co., Pittsburgh, Pa.

** Indicates that the manufacturer carries an advertisement. See index facing inside back cover.*

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St. Louis Screw Co., St. Louis, Mo.
Sweet's Steel Co., Williamsport, Pa.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.

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Goodall Rubber Co., Inc., Philadelphia, Pa.
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Salisbury & Co., Inc., W. H., Chicago, Ill.
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*Ransome Concrete Machy. Co., Dunellen, N. J.
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Berger Mfg. Co., Canton, Ohio.
Fairfield Engineering Co., Lancaster, Ohio.
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Green Engineering Co., E. Chicago, Ind.
Link-Belt Co., Chicago, Ill.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.

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BLASTING POWDER (See Explosives)

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Broderick & Bascom Rope Co., St. Louis, Mo.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Topping Bros., N. Y. C.
Upson-Walton Co., Cleveland, Ohio.

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American Blower Co., Detroit, Mich.
American Gas Furnace Co., N. Y. C.
De Laval Steam Turbine Co., Trenton, N. J.
Spencer Turbine Co., Hartford, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

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Babcock & Wilcox Co., N. Y. C.
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Casey-Hedges Co., Chattanooga, Tenn.
Chandler & Taylor Co., Indianapolis, Ind.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
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Flory Mfg. Co., S., Bangor, Pa.
Hartley Boiler Works, Montgomery, Ala.
Heine Safety Boiler Co., St. Louis, Mo.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Industrial Works, Bay City, Mich.
Ladd Co., Geo. T., Pittsburgh, Pa.
Leffel & Co., J., Springfield, O.
Lord & Burnham Co., Irvington, N. Y.
Murray Iron Works Co., Burlington, Ia.
New Bern Iron Wks. & Sup. Co., New Bern, N. C.
Petroleum Iron Works Co., Sharon, Pa.
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Schofield Iron Works, Macon, Ga.
Traylor Engr. & Mfg. Co., Allentown, Pa.
Valk & Murdoch Co., Charleston, S. C.
Vogt Mchy. Co., Inc., Louisville, Ky.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

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American Spike Co., N. Y. C.
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Scranton Bolt & Nut Co., Scranton, Pa.
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Sweet's Steel Co., Williamsport, Pa.

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*Duff Mfg. Co., Pittsburgh, Pa.
*Waldo Bros. & Bond Co., Boston, Mass.

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*Mueller Mfg. Co., H., Decatur, Ill.
*Union Water Meter Co., Worcester, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
United Brass Mfg. Co., Cleveland, O.

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American Bridge Co., N. Y. C.
Bellefontaine Bridge & Steel Co., Bellefontaine, O.
Belmont Iron Works, Philadelphia, Pa.
Berlin Constr. Co., Berlin, Conn.
Bethlehem Steel Bridge Corp., Bethlehem, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Boston Bridge Works, Boston, Mass.
Central States Bridge Co., Indianapolis, Ind.
Champion Bridge Co., Wilmington, O.
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Clinton Bridge Wks., Clinton, Iowa.
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Morava Constr. Co., Chicago, Ill.
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Penn. Bridge Co., Beaver Falls, Pa.
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Riverside Bridge Co., Martins Ferry, O.
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Insley Mfg. Co., Indianapolis, Ind.
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Marchant Calc. Machine Co., Oakland, Cal.

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Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Oliver Mfg. Co., W. J., Knoxville, Tenn.
Stuebner Iron Works, G. L., Long Island City, N. Y.
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Whiting Corp'n, Harvey, Ill.

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Smith Co., T. L., Milwaukee, Wis.
Standard Scale & Supply Co., Pittsburgh, Pa.
Sterling Wheelbarrow Co., Milwaukee, Wis.
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*Lynchburg Fdry. Co., Lynchburg, Va.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N.J.
*Warren Fdry. & Mach. Co., N. Y. C.
American Cast Iron Pipe Co., Birmingham, Ala.
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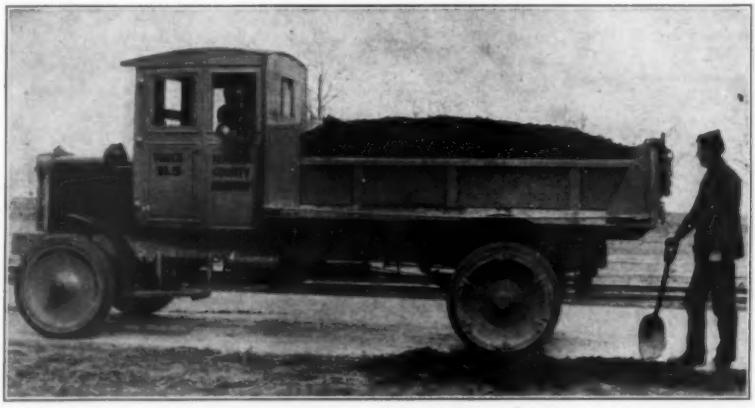

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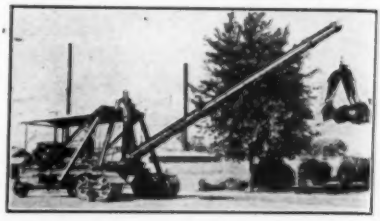

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Defiance Mfg. Co., New York.
Dietzgen Co., E., New York.
Economy Draw. Table & Mfg. Co., Adrian, Mich.
Gurley, W. & L. E., Troy, N. Y.
Hamilton Mfg. Co., Two Rivers, Wis.
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.
Lietz Co., A., San Francisco, Cal.
Spaulding-Moss Co., Boston, Mass.
Weber & Co., F., Philadelphia, Pa.

DREDGES
*Bay City Dredge Works, Bay City, Mich.
*Bucyrus Co., South Milwaukee, Wis.
Ellicott Machine Corp'n., Baltimore, Md.
Hayward Co., New York.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Osgood Co., The, Marion, O.
Stockton Iron Works, Stockton, Cal.
Superior Iron Works, Superior, Wis.
Vulcan Iron Works, Jersey City, N. J.

DREDGES, DIPPER
*Bay City Dredge Works, Bay City, Mich.
*Bucyrus Co., South Milwaukee, Wis.
American Steel Dredge Co., Fort Wayne, Ind.
Austin Machinery Corp'n, Chicago, Ill.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.

DREDGES, HYDRAULIC
*Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore, Md.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.

DREDGING PUMPS AND ACCESSORIES
Erie Pump & Engine Wks., Medina, N. Y.

DRILLS, AIR
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, CORE
*McKiernan-Terry Drill Co., New York.
Dobbins Core Drill Co., Inc., New York.
Ingersoll-Rand Co., New York.
Standard Diamond Drill Co., Chicago, Ill.

DRILLS, HAMMER
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

What Other Kind of Road Could Stand This?

For nearly four years the road illustrated above has stood up under the heaviest kind of traffic, both as to weight of loads and number of vehicles.

Truck loads of cement weighing from 20 to 30 tons passed regularly over this road—for months at a time, the daily average being 180 loads.

Today this road is in perfect condition, without one cent having been spent for repairs.

STANOLIND
PAVING ASPHALT "B"
was used in the construction of this road

Our booklet "Stanolind Paving Asphalt" containing information regarding this type of road as well as all other asphaltic roads, will be mailed free upon request.

STANDARD OIL COMPANY
(INDIANA)
910 So. Michigan Ave. Chicago, Ill.

DRILLS, ROCK
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.
Wood Drill Works, Paterson, N. J.

DRILLS FOR WELLS AND BLAST HOLES
(See Well Drilling Machinery)

DRUMS, HOLDING
Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works, Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Monighan Machine Co., Chicago, Ill.

DRYERS, ASPHALT AND CEMENT
*Allis-Chalmers Co., Milwaukee, Wis.
American Blower Co., Detroit, Mich.
American Process Co., New York.
Atlas Dryer Co., Cleveland, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, O.
Ruggles-Coles Eng. Co., New York.
Variety Iron & Steel Works, Cleveland, O.

DUMP BODIES FOR MOTOR TRUCKS
*Heil Company, Milwaukee, Wis.
*International Motor Co., New York.
*Littleford Bros., Cincinnati, O.
American Truck Body Co., Inc., Martinsville, Va.
Archer Iron Works, Chicago, Ill.
Auto Truck Steel Body Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Horizontal Hydraulic Hoist Co., Detroit, Mich.
Jennings Automatic Dump Body, Roanoke, Va.
Lee Trailer & Body Co., Chicago, Ill.
Pechstein Iron Works, Keokuk, Iowa.
Simplex Mfg. Co., Conneautville, Pa.
Van Dorn Iron Wks., Cleveland, Ohio.
Wood Hydraulic Hoist & Body Co., Detroit, Mich.

DUMP CARTS AND WAGONS, HORSE DRAWN
*Acme Road Machinery Co., Frankfort, N. Y.
*Austin Western Road Mchy. Co., Chicago, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Tiffin Wagon Co., Tiffin, Ohio.
Acme Wagon Co., Emigsville, Pa.
Arcadia Trailer Corp., Newark, N. Y.
Austin Mfg. Co., Chicago, Ill.
Eagle Wagon Works, Auburn, N. Y.
Holsbog & Bro., Geo. H., Jeffersonville, Ind.
Stroud & Co., Omaha, Nebr.
Watson Products Corp., Canastota, N. Y.

DUST LAYING AND ROAD BINDER MATERIALS
*Barrett Co., New York.
*Standard Oil Co. (Indiana), Chicago, Ill.
Dow Chemical Co., Midland, Mich.
Dustoline for Roads Co., Summit, N. J.
Semet-Solvay Co., Solvay, N. Y.
Texas Co., New York.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE
Pacific Flush Tank Co., Chicago, Ill.
Yeomans Bros. Co., Chicago, Ill.

ELECTRIC GENERATORS AND MOTORS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Ideal Elec. & Mfg. Co., Mansfield, O.
Triumph Electric Co., Cincinnati, O.
Western Electric Co., New York.

ELECTRIC LAMPS
*General Electric Co., Schenectady, N. Y.
*Westinghouse Lamp Co., New York.

ELECTRIC LIGHTING PLANTS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Western Electric Co., New York

ELECTRIC MOTORS
*Allis Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Crocker-Wheeler Co., Ampere, N. J.
Lincoln Electric Co., Cleveland, Ohio.
Robbins & Myers Co., Springfield, O.
Triumph Electric Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.

ELECTRIC SUPPLIES, METERS, ETC.
*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Bissell Co., F., Toledo, Ohio.

ELECTRIC TRANSFORMERS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*General Electric Co., Schenectady, New York.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Kuhlman Electric Co., Bay City, Mich.

ELECTRIC WIRES AND CABLES. (See "Wire and Cable")

ELEVATORS, BUCKET
*Austin Western Road Machy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Philadelphia, Pa.
*Littleford Bros., Cincinnati, Ohio.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Weller Mfg. Co., Chicago, Ill.
Atlas Eng. Co., Milwaukee, Wis.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Haiss Mfg. Co., Geo., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Robins Conv. Belt Co., N. Y. C.
Webster Mfg. Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

ELEVATORS, CONTRACTING MATERIAL
*Byers Machine Co., Ravenna, O.
*Ransome Concrete Machy. Co., Dunellen, N. J.
American Hoist & Derrick Co., St. Paul, Minn.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Insley Mfg. Co., Indianapolis, Ind.

ELEVATORS, FACTORY
*Weller Mfg. Co., Chicago, Ill.
Otis Elevator Co., New York.
Ridgway & Son Co., C., Coatesville, Pa.
Speidel, J. G., Reading, Pa.
Standard Conveyor Co., No. St. Paul, Minn.
Webster Mfg. Co., Chicago, Ill.

ELEVATORS, PASSENGER AND FREIGHT
Haughton Elevator & Mach. Co., Toledo, Ohio.
Otis Elevator Co., New York.
See Elec. Elevator Co., A. B., New York.
Warner Elevator Mfg. Co., Cincinnati, O.

ENGINES, GAS AND GASOLINE
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*Holt Mfg. Co., Peoria, Ill.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., New York.
Domestic Engine & Pump Co., Shippensburg, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Fuller & Johnson Mfg. Co., Madison, Wis.
Gade Bros. Mfg. Co., Iowa Falls, Iowa.
"New-Way" Motor Co., Lansing, Mich.
Novo Engine Co., Lansing, Mich.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., New York.

ENGINES, HIGH DUTY WATER-WORKS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Worthington Pump & Mchy. Corp., New York.

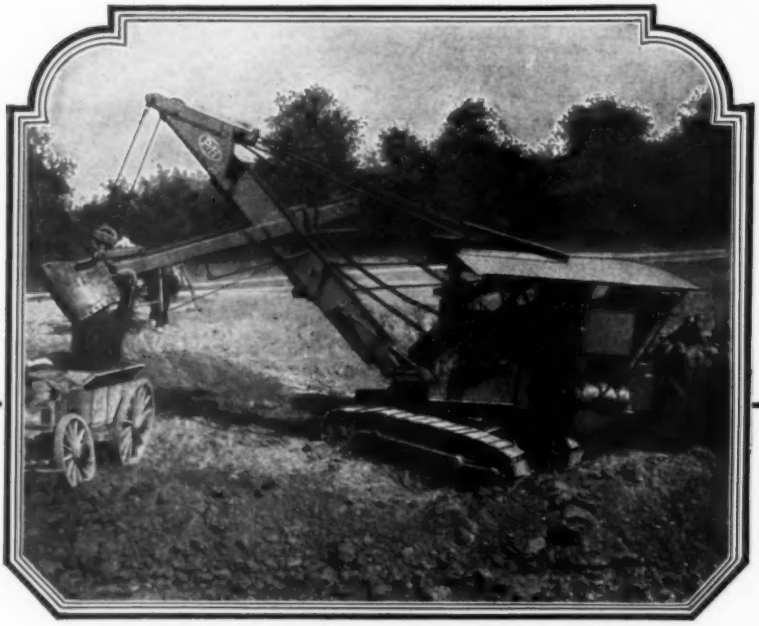
ENGINES, OIL

DIESEL

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
Dodge Sales & Eng. Co., Mishawaka, Ind.
Fulton Iron Works Co., St. Louis, Mo.
McIntosh & Seymour Corp., Auburn, N. Y.
Nordberg Mfg. Co., Milwaukee, Wis.

SEMI-DIESEL

Advance Rumely Thresher Co., La Porte, Ind.
Anderson Fdry. & Mach. Co., Anderson, Ind.
Bessemer Gas Eng. Co., Grove City, Pa.
Buckeye Machinery Co., Lima, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
De La Vergne Machine Co., New York.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, O.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Mietz Corp'n. Aug., New York.
Muncie Oil Eng. Co., Muncie, Ind.
Nordberg Mfg. Co., Milwaukee, Wis.
St. Mary's Oil Eng. Co., St. Charles, Mo.
Stover Steel Tank & Mfg. Co., Freeport, Ill.



New Facts on Shovels

Water Supply and Fuel Troubles Eliminated

One Man Operated

This alone is an important factor. A licensed engineer and fireman are not needed. A green man is broken in within a few days by our demonstration. This one operator has within easy reach all the control levers required to swing the boom, lower the bucket, dig and empty the bucket, and maneuver the entire shovel on its corduroy traction.

No Water and Fuel Troubles

The water for the radiator is all that is required. No water pipe line need be led to the machine. The fuel (gasoline) is easily carried. No matter how remote the location, P & H Gas Shovels operate as easily as in city or town. As an example, the P & H Gas Shovel operated by C. Miles, contractor, 3,000 feet above sea level in the Santa Cruz Mountains, excavated and overcast a road at a cost that was 30 per cent less than the cost estimated by experienced contractors. This contractor made money on a job where another went broke.

There is no need to keep up a fire all night, or get it started an hour or so before intending to use—since the P & H Gas Shovel is as easy to start as a motor truck. No fuel is used except when the shovel is **actually in operation.**

P & H Shovel Attachment Is Interchangeable With the Standard Excavator-Crane Boom

By removing the Shovel Attachment and replacing it with the standard boom, the user has a portable, corduroy-traction crane, capable of use as a general material handling crane, and as a dragline excavator.

This interchangeability feature provides two machines at the cost of one plus the cost of a boom or shovel attachment.

Get your excavating work done at lower cost by using the P & H Gas Shovel on your shovel job—the gas shovel with real crowding motion.

Excavating Machinery Division

PAWLING & HARNISCHFEGER CO.

In Milwaukee since 1884

Offices and agents in principal cities.

P&H GAS SHOVEL

Taylor Machine Co., Cleveland, O.
Weber Engine Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., New York.

ENGINES, PUMPING
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*American Well Works, Aurora, Ill.
*Dayton-Dowd Co., Quincy, Ill.
*Fairbanks Morse & Co., Chicago, Ill.
*Nordberg Mfg. Co., Milwaukee, Wis.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
American Gas Engine Co., Kansas City, Mo.
Deming Co., Salem, O.
Enterprise Mchy. Co., Minneapolis, Minn.
Midwest Engine Co., Indianapolis, Ind.
United Iron Works, Inc., Kansas City, Mo.
Weinman Pump Mfg. Co., Columbus, O.
Worthington Pump & Mchy. Corp., New York.

ENGINES, STEAM
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Nordberg Mfg. Co., Milwaukee, Wis.
Dake Engine Co., Grand Haven, Mich.
Erie-Ball Engine Co., Pittsburgh, Pa.
Erie Pump & Engine Co., Medina, N. Y.
Filer-Stowell Co., Milwaukee, Wis.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Leffel Co., J., Springfield, O.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Vilter Mfg. Co., Milwaukee, Wis.

ENGINES, TRACTION
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Fairbanks, Morse & Co., Chicago, Ill.
*Holt Mfg. Co., Peoria, Ill.
Oliver Tractor Co., Knoxville, Tenn.
Phoenix Mfg. Co., Eau Claire, Wis.

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

EXCAVATORS, CABLEWAY
*Bucyrus Co., South Milwaukee, Wis.
*Byers Machine Co., Ravenna, O.
Ball Eng. Co., Erie, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Smith Co., T. L., Milwaukee, Wis.

EXCAVATORS, DITCH AND TRENCH
*Bay City Dredge Works, Bay City, Mich.
*Bucyrus Co., South Milwaukee, Wis.
*Byers Machine Co., Ravenna, O.
*Keystone Driller Co., Beaver Falls, Pa.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Chicago, Ill.
Ball Engine Co., Erie, Pa.
Buckeye Traction Ditcher Co., Findlay, O.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., The, New York City.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.

EXCAVATORS, DRAG-LINE
*Bay City Dredge Works, Bay City, Mich.
*Bucyrus Co., South Milwaukee, Wis.
*Byers Machine Co., Ravenna, O.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Austin Machinery Corp'n, Chicago, Ill.
Browning Co., Cleveland, O.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Gade, C. L., Iowa Falls, Iowa.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.
Smith Co., T. L., Milwaukee, Wis.

EXPANDED METAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consolidated Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Northwestern Expanded Metal Co., Chicago, Ill

EXPANSION JOINT MATERIAL
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Barrett Co., New York.
*Carey Co., Philip, Cincinnati, Ohio.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Truscon Steel Co., Youngstown, O.
*Waring-Underwood Co., Philadelphia, Pa.
Texas Company, New York.

EXPLOSIVES
*Du Pont de Nemours & Co., E. I., Wilmington, Del.
Atlas Powder Co., Wilmington, Del.
Giant Powder Co., Cons., San Francisco, Cal.
Hercules Powder Co., Wilmington, Del.

FENCING
American Steel & Wire Co., Chicago, Ill.
Anchor Post Iron Works, New York.
Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Cleveland, O.
Indiana Steel & Wire Co., Muncie, Ind.
Kitselman Bros., Muncie, Ind.
Pittsburgh Steel Co., Pittsburgh, Pa.
Stewart Iron Works Co., Cincinnati, Ohio.
Texas Cyclone Fence Co., Fort Worth, Tex.
Wickwire Spencer Steel Corp'n, Worcester, Mass.

FILING EQUIPMENT, STEEL
Art Metal Constr. Co., Jamestown, N. Y.
Berger Mfg. Co., Canton, O.
Econ. Drawing Table & Mfg. Co., Adrian, Mich.
Van Dorn Iron Works, Cleveland, O.

FILTERS, OIL
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Wayne Oil Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER
*Norwood Engineering Co., Florence, Mass.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
American Water Softener Co., Philadelphia, Pa.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewel Filtr. Co., Nutley, N. J.
Roberts Filter Co., Darby, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.

FIRE ALARM SYSTEMS
Gamewell Fire Alarm Tel. Co., Newton Upper Falls, Mass.

FIRE APPARATUS, MOTOR
*International Motor Co., New York.
Ahrens-Fox Fire Engine Co., Cincinnati, O.
American-La France Fire Eng. Co., Elmira, N. Y.
Brockway Motor Fire App. Co., Cortland, N. Y.
Childs Co., O. J., Utica, N. Y.
Prospect Mfg. Co., Prospect, O.
Seagrave Co., Columbus, O.
Stutz Fire Engine Co., Indianapolis, Ind.

FIRE EXTINGUISHERS, CHEMICAL
American-La France Fire Eng. Co., Elmira, N. Y.
Childs Co., O. J., Utica, N. Y.
Cross Mfg. Co., C. J., Inc., New York.
Foamite Firefoam Co., New York.
Pyrene Mfg. Co., New York.

FIREPROOF BUILDING MATERIAL
*Delaware Clay Products Co., Pittsburgh, Pa.
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Detroit Steel Prod. Co., Detroit, Mich.
General Fireproofing Co., Youngstown, O.
Keasbey & Mattison Co., Ambler, Pa.
Kinnear Mfg. Co., Columbus, O.
National Fireproofing Co., Pittsburgh, Pa.
United States Gypsum Co., Chicago, Ill.

FIRST AID EQUIPMENT
American-La France Fire Eng. Co., Elmira, N. Y.

FLEXIBLE JOINTS
*Central Foundry Co., New York.
*Crane Co., Chicago, Ill.
*United Lead Company, New York.
*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
Coldwell-Wilcox Co., Newburgh, N. Y.
Lunkenheimer Co., Cincinnati, O.

FLOORS, WOOD BLOCK
*Barrett Co., New York.
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Toledo, O.
Republic Creosoting Co., Indianapolis, Ind.
Southern Wood Pres. Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

FLUSH TANKS
Pacific Flush Tank Co., Chicago, Ill.

FLUSHERS, STREET. (See Street Flushers and Sprinklers.)

FORGES
Buffalo Forge Co., Buffalo, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.

FORM CLAMPS
Insley Mfg. Co., Indianapolis, Ind.
Marion Malleable Iron Works, Marion, Ind.
Universal Form Clamp Co., Chicago, Ill.

ROYTRAC

UNIT WHEELERS

are time and money savers, and will increase your daily yardage many times.

Work successfully behind all tractors.

Actual measured capacity 20 cu. ft. By heaping loads 22 cu. ft. can be loaded.

Write for Special Bulletin F118

SMITH & SONS MFG. CO.

1512 Guinotte Kansas City, Mo.

10 Gallon Capacity

CONNERYS'

Tar and Asphalt Heaters

Non-Leakable Welded—"Held by the Weld." 20 Styles.

10 to 1000 Gallon Capacity Carried in Stock.

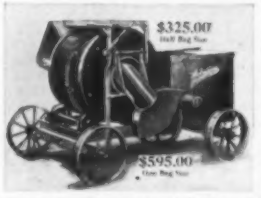
This kettle (10-gallon capacity) is ideal for road contractors and is especially made for small patch work where there are a considerable number of small holes to be properly filled up with gravel or crushed stone and cemented with bituminous binder. The inside pot lifts out and can readily be used as a pouring pot.

Send your name for illustrated material on all sizes and styles.

CONNERY & CO., Inc.

400 N. SECOND STREET, PHILADELPHIA, PA.

WOLVERINE MIXERS A Knickerbocker Product



¶ The Wolverine Concrete Mixers successfully fill a big need right now, both in the building field and in the construction of sidewalks, bridges and culverts, for a well made, low priced mixer.

¶ The special design of these mixers, together with the quantity built, permits us to make them the desired weight for portability, and of sufficient strength to withstand the hard work they are subjected to on the job, and still sell them at exceedingly low prices.

THE KNICKERBOCKER CO., 326 Liberty St., JACKSON, MICH., U. S. A.

Knickerbocker Line of Concrete Mixers, Mortar Mixers, Portable Saw Rigs

BAKER MANEY Self-Loading SCRAPERS

They dig, load, haul, dump and spread

Write to

THE BAKER MFG. CO.

503 Stanford Ave., Springfield, Ill.

Everything in Reinforcement for Concrete Roads

TRUSCON STEEL CO. TRUSCON BUILDING PRODUCTS

Truscon Wire Mesh, furnished in flat sheets cut to length, is a superior reinforcement especially made for concrete highways.

Truscon Road Mesh is an expanded metal with 6" x 12" diamond mesh; furnished in flat sheets 5ft. wide and various lengths.

Truscon Curb Bars protect and reinforce the concrete curbs. Positive anchorage; easy to handle and install.

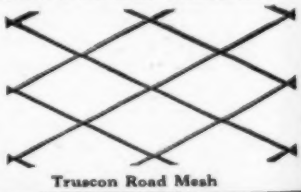
TRUSCON STEEL COMPANY

Youngstown, Ohio

Warehouses and Sales Offices in Principal Cities

Truscon Curb Bars

Truscon Wire Mesh



Truscon Road Mesh

FORMS, CONSTRUCTION
*Connery & Co., Philadelphia, Pa.
*Truscon Steel Co., Youngstown, O.
Blaw-Knox Co., Pittsburgh, Pa.
Concrete Form Co., Inc., Syracuse, N. Y.
Heltzel Steel Form & Iron Co., Warren, O.
Hydraulic Steelcraft Co., Cleveland, O.
Metal Forms Corp., Milwaukee, Wis.

FOUNTAINS, SANITARY
Clow & Sons, Jas. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Murdock Mfg. & Supply Co., Cincinnati, Ohio.
Puro Sanitary Drinking Fountain Co., Haydenville, Mass.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
Stewart Iron Works Co., Cincinnati, O.

FURNITURE AND FILES, STEEL
Art Metal Constn. Co., Jamestown, N. Y.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works Co., Cleveland, O.

GARBAGE CANS. **(See Cans)**

GARBAGE DISPOSAL
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
Decarie Incinerator Co., Minneapolis, Minn.
Destructor Co., New York.
Jeffrey Manufacturing Co., Columbus, O.
Morse-Boulger Destructor Co., New York.
Nye Odorless Crematory Co., Macon, Ga.

GARBAGE TRUCKS AND WAGONS
*Austin Western Road Mchy. Co., Chicago, Ill.
*Autocar Co., Ardmore, Pa.
*International Motor Co., New York.
*Tiffin Wagon Co., Tiffin, O.
*White Co., Cleveland, O.
Federal Motor Truck Co., Detroit, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
Holabog & Bro., Geo. H., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago, Ill.
Service Motor Truck Co., Wabash, Ind.
Watson Products Corp., Canastota, N. Y.

GAS ENGINES. **(See Engines, Gas and Gasoline.)**

GAS METERS
*General Electric Co., Schenectady, New York.
*Pittsburg Meter Co., East Pittsburgh, Pa.
Builders Iron Foundry, Providence, R. I.

GAS PRODUCERS
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Camden Iron Works, Camden, N. J.

GASOLINE STORAGE TANKS
*Byers Machine Co., Ravenna, O.
*Heil Co., Milwaukee, Wis.
*Honhorst Co., Jos., Cincinnati, Ohio.
*Littleford Bros., Cincinnati, O.
Biggs Boiler Works, Akron, Ohio.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Chicago Bridge & Iron Works, Chicago, Ill.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
Wayne Oil Tank & Pump Co., Ft. Wayne, Ind.

GATES, SLUICE
*Crane Co., Chicago, Ill.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Boston, Mass.
Coldwell-Wilcox Co., Newburgh, N. Y.
Columbian Iron Works, Chattanooga, Tenn.
Eddy Valve Co., Waterford, N. Y.
Hardesty Mfg. Co., The, Denver, Col.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
Rensselaer Valve Co., Troy, N. Y.
Wood & Co., R. D., Philadelphia, Pa.

GAUGES, RECORDING, PRESSURE, STEAM
Bristol Co., Waterbury, Conn.
Crosby Steam Gauge & Valve Co., Boston, Mass
Marsh & Co., Jas. P., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y
U. S. Gauge Co., New York.

GAUGES, WATER
Bristol Co., Waterbury, Conn.
Clow & Sons, J. B., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
United States Gauge Co., New York.
Walworth Mfg. Co., Boston, Mass.

GAUGES, SURFACE, RESERVOIR AND SPECIAL WATER-WORKS
Builders Iron Foundry, Providence, R. I.
Clark Co., H. W., Mattoon, Ill.
Simplex Valve & Meter Co., Philadelphia, Pa.

GLASS, FIREPROOF. **(See Wire Glass.)**

GRADERS, ROAD
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Mchy. Co., Philadelphia, Pa.
*Holt Mfg. Co., Peoria, Ill.
*Koehring Co., Milwaukee, Wis.
Adams & Co., J. D., Indianapolis, Ind.
Case Threshing Machine Co., J. I., Racine, Wis.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Russell Grader Mfg. Co., Minneapolis, Minn.

GRINDERS AND SAND RAMMERS
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, Ohio.
Ingersoll-Rand Co., New York, N. Y.

GYPSUM PRODUCTS
U. S. Gypsum Co., Chicago, Ill.

HAMMERS, STEAM, PILE. **(See Pile Hammers, Steam.)**

HEAT INSULATING MATERIAL
*Carey Co., Philip, Cincinnati, Ohio.
Johns-Manville, Inc., New York.

HEATERS AND DISTRIBUTORS, TAR AND ASPHALT HEATING KETTLES
*Kinney Mfg. Co., Boston, Mass.

HEATING KETTLES. **(See Kettles)**

HOISTS, BELT-DRIVEN
*Weller Mfg. Co., Chicago, Ill.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mundy Hoisting Engine Co., J. S., Newark, N. J.

HOISTS, CONCRETE, TOWER
*Ransome Concrete Machy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

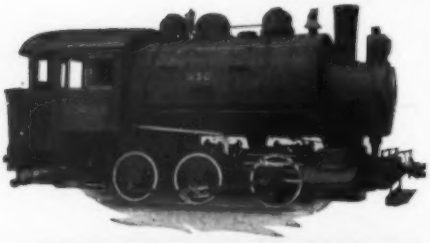
HOISTS, CONTRACTORS', ELECTRIC
American Hoist & Derrick Co., St. Paul, Minn.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Patten Mfg. Co., Chattanooga, Tenn.
Treadwell Eng. Co., Easton, Pa.

HOISTS, CONTRACTORS', GASOLINE
American Cement Mach. Co., Keokuk, Ia.
Austin Machinery Corp'n, Chicago, Ill.
Buffalo Hoist & Derrick Co., Buffalo, N. Y.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Construction Machy. Co., Waterloo, Iowa.
Domestic Engine & Pump Co., Shippensburg, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Lansing Co., Lansing, Mich.
Lidgerwood Mfg. Co., New York.
Monighan Machine Co., Chicago, Ill.
Mundy Hoisting Engine Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Novo Engine Co., Lansing, Mich.
O. K. Clutch & Mach. Co., Columbia, Pa.
Patten Mfg. Co., Chattanooga, Tenn.
Schramm & Son, Inc., Chris. D., West Chester, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.

HOISTS, CONTRACTORS', STEAM
*Byers Machine Co., Ravenna, O.
*Denver Rock Drill Mfg. Co., Denver, Colo.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Chicago, Ill.
Clyde Iron Works Sales Co., Duluth, Minn.
Flory Mfg. Co., S., Bangor, Pa.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Treadwell Eng. Co., Easton, Pa.

HOISTS FOR MOTOR TRUCKS
*Heil Co., The Milwaukee, Wis.
Horizontal Hydr. Hoist Co., Detroit, Mich.
Perfection Hoist & Engine Co., Two Rivers, Wis.
Wood Hydr. Hoist & Body Co., Detroit, Mich.

HOISTS, PNEUMATIC
*Denver Rock Drill Mfg. Co., Denver, Colo.
Chicago Pneumatic Tool Co., New York
Detroit Hoist & Machine Co., Detroit, Mich.
Flory Mfg. Co., Bangor, Pa.
Hanna Eng. Works, Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.



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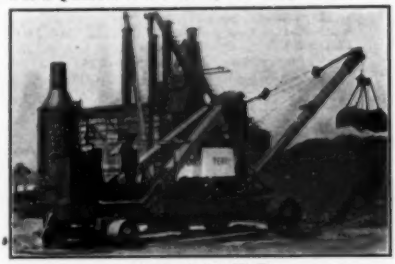

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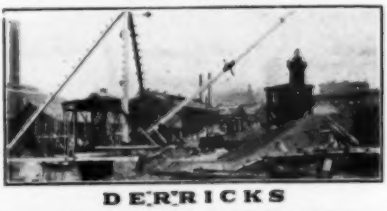

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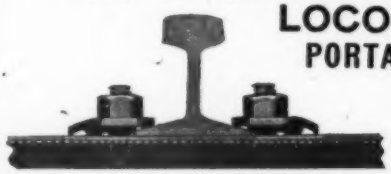

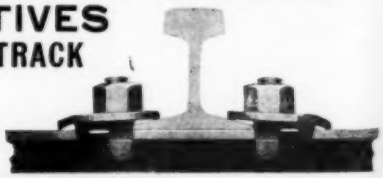

SWITCHES-FROGS-CROSSINGS
LIGHT RAILWAY EQUIPMENT COMPANY
Commercial Trust Building PHILADELPHIA, PA.

Northern Engineering Works, Detroit, Mich.
Worthington Pump & Mchy. Corp., New York.

HOLLOW TILE
*Delaware Clay Products Co., Pittsburgh, Pa.
Bannon Pipe Co., P., Louisville, Ky.
Dee Co., Wm. E., Chicago, Ill.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Medal Paving Brick Co., Cleveland, Ohio.
Metropolitan Paving Brick Co., Canton, Ohio.
National Fireproofing Co., Pittsburgh, Pa.

HOPPERS, CONCRETE
*Koehring Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*Ransome Concrete Machy. Co., Dunellen, N. J.
*Weller Mfg. Co., Chicago, Ill.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

HOSE, AIR
Cincinnati Rubber Mfg. Co., Cincinnati, O.
Goodyear Tire & Rubber Co., Akron, O.
Ingersoll-Rand Co., New York.
Penna Flexible Metallic Tubing Co., Phila., Pa.
Republic Rubber Co., Youngstown, O.
U. S. Rubber Co., New York

HOSE, FIRE
Bi-Lateral Fire Hose Co., Chicago, Ill.
Fabric Fire Hose Co., New York.
Goodrich Rubber Co., B. F., Akron O.
U. S. Rubber Co., New York.

HOUSES, PORTABLE. (See Buildings, Portable)

HYDRANTS, FIRE
*Smith Mfg. Co., A. P., East Orange, N. J.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Mfg. Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
Norwood Engineering Co., Florence, Mass.
Rensselaer Valve Co., Troy, N. Y.
Wood & Co., R. D., Philadelphia, Pa.

INCINERATORS, GARBAGE. (See Garbage Disposal)

INDICATOR POSTS. (See Valves)

INSPECTING LABORATORIES
Allentown Testing Laboratories, Allentown, Pa.
Conard & Busby, Burlington, N. J.
Hunt & Co., Robert W., Chicago, Ill.
Pittsburgh Testing Laboratories, Pittsburgh, Pa.

INSTRUMENTS AND SUPPLIES. (Surveyors' and Engineers')
Ainsworth & Sons, Wm., Denver, Col.
Aloe Co., A. S., St. Louis, Mo.
Berger & Sons, C. L., Boston, Mass.
Brandis & Sons Mfg. Co., Brooklyn, N. Y.
Buff & Buff Mfg. Co., Boston, Mass.
Dietzgen Co., Eugene, Chicago, Ill.
Gurley, W. & L. E., Troy, N. Y.
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.
Lietz Co., A., San Francisco, Cal.
Leupold & Voelpel, Portland, Ore.
Pfister, Wm. H., Cincinnati, O.
Ulmer, J. C., Co., Cleveland, Ohio.
Weber & Co., F., Philadelphia, Pa.
White Co., David, Milwaukee, Wis.
Wissler Instrument Co., St. Louis, Mo.

IRON WORK, STRUCTURAL AND ORNAMENTAL (See Bridges and Buildings)

JACKS, LIFTING
*Duff Mfg. Co., Pittsburgh, Pa.
*McKiernan-Terry Drill Co., New York.
Buda Company, Chicago, Ill.
Iron City Prod. Co., Pittsburgh, Pa.
Joyce-Cridland Co., Dayton, O.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Norton, Inc., A. O., Boston, Mass.
Watson-Stillman Company, New York.

JACKS, PIPE FORGING
*Duff Mfg. Co., Pittsburgh, Pa.
Clark Co., H. W., Mattoon, Ill.

JAIL AND PRISON WORK
Barnum Iron Works, E. T., Detroit, Mich.
Stewart Iron Works Co., Cincinnati, Ohio.
Van Dorn Iron Works Co., Cleveland, O.

JOINTS, EXPANSION PAVING
*Carey Company, Philip, Cincinnati, O.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Servicised Products Co.
*Warins-Underwood Co., Philadelphia, Pa.

JOINTS, FLEXIBLE PIPE. (See Flexible Joints.)

KETTLES, FOR ASPHALT AND TAR HEATING
*Acme Road Mach. Co., Frankfort, N. Y.
*Barber Asphalt Paving Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Good Roads Machinery Co., Kennett Square, Pa.
*Heuhorst Co., Jos., Cincinnati, O.
*Kinney Mfg. Co., Boston, Mass.
*Littleford Bros., Cincinnati, O.
Hauck Mfg. Co., Brooklyn, N. Y.
Macleod Co., Cincinnati, O.
Stuebner Iron Wks., G. L., Long Island City, N. Y.
Tarrant Mfg. Co., Saratoga Springs, N. Y.

LATH, METAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Bostwick Steel Lath Co., Niles, O.
Consol. Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
General Fireproofing Co., Youngstown, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Northwestern Expanded Metal Co., Chicago, Ill.
Penn Metal Co., Boston, Mass.
Sykes Metal Lath & Roofing Co., Niles, O.
Wickwire Spencer Steel Corp., Worcester, Mass.
Youngstown Pressed Steel Co., Warren, O.

LEADITE
Leadite Co., The, Philadelphia, Pa.

LEAD-MELTING FURNACES
Berns, Otto, Co., Newark, N. J.
Chicago Flexible Shaft Co., Chicago, Ill.
Gilbert & Barker, Springfield, Mass.
Hauck Mfg. Co., Brooklyn, N. Y.
Stuebner Iron Works, Long Island City, N. Y.

LEAK FINDERS
*Pitometer Company, New York.
Clark & Co., H. W., Mattoon, Ill.

LETTERS AND FIGURES, METAL
Niagara Metal Stamp. Corp., Niagara Falls, N. Y.

LIGHTS, CONTRACTORS
*General Elec. Co., Schenectady, N. Y.
Carbic Mfg. Co., Duluth, Minn.
Hauck Mfg. Co., Brooklyn, N. Y.
Macleod Co., Cincinnati, O.
Milburn Co., Alex., Baltimore, Md.
Prest-O-Lite Co., Inc., New York.

LIGHTING STANDARDS
*Electric Railway Equip. Co., Cincinnati, O.
*King Mfg. Co., Chicago, Ill.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Clow & Sons, J. B., Chicago, Ill.
Stewart Iron Works Co., Cincinnati, O.
Union Metal Mfg. Co., Canton, O.

LIQUID CHLORINE
*Electro Bleaching Gas Co., New York.
*Mathieson Alkali Works, Inc., New York.
*Penna. Salt Mfg. Co., Philadelphia, Pa.

LOADERS, GRAVEL AND WAGON
*Bay City Dredge Works, Bay City, Mich.
*Weller Mfg. Co., Chicago, Ill.
Atlas Engineering Co., Milwaukee, Wis.
Austin Machinery Corp'n, Chicago, Ill.
Barber-Greene Co., Aurora, Ill.
Bonney Supply Co., Inc., Rochester, N. Y.
Economy Excavator Co., Iowa Falls, Iowa.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Haiss Mfg. Co., Geo., New York.
Lee Trailer & Body Co., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Portable Mchy. Co., Passaic, N. J.
Sackett Screen & Chute Co., H. B., Chicago, Ill.
Sauerman Bros., Chicago, Ill.
Smith Co., T. L., Milwaukee, Wis.

LOCK BAR STEEL PIPE
East Jersey Pipe Co., New York.

LOCKERS, STEEL
Hart & Hutchinson Co., New Britain, Conn.
Medart Mfg. Co., Fred., St. Louis, Mo.

LOCOMOTIVES, FOR CONTRACTORS, ETC.
*Koppel Industrial Car & Equip. Co., Koppel, Pa.
*Light Ry. Equipment Co., Philadelphia, Pa.
*Porter Co., H. K., Pittsburgh, Pa.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
American Locomotive Co., New York, N. Y.
Austin Machinery Corp'n, Chicago, Ill.
Baldwin Locomotive Works, Philadelphia, Pa.
Burton Eng. & Mach. Co., Cincinnati, O.
Crapster, Herbert, New York.
Cummings Mach. Co., Minster, O.
Davenport Locomotive Works, Davenport, Ia.
Fate-Root-Heath Co., Plymouth, O.

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Vulcan Iron Works, Wilkes-Barre, Pa.
Whitcomb Co., Geo. D., Rochelle, Ill.

LUMBER, HEAVY CONSTRUCTION
Brown Co., Portland, Me.
Crowell & Spencer Lumber Co., Long Leaf, La.
Great Southern Lumber Co., Bogalusa, La.
Industrial Lumber Co., Elizabeth, La.
Long Bell Lumber Co., Kansas City, Mo.
Sargent Lumber Co., Little Rock, Ark.
Sterner Co., Inc ., E. J., New York.
Weyerhaeuser Sales Co., Spokane, Wash.

LUMBER, STEEL
*Truscon Steel Co., Detroit, Mich.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
National Pressed Steel Co., Massillon, O.
Northwestern Exp. Metal Co., Chicago, Ill.

MANHOLE COVERS (See Catch Basins)

METAL LATH. (See "Lath")

METAL ROOFING (See "Roofing)

METER BOXES
*Mueller Mfg. Co., H., Decatur, Ill.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
Clark Co., H. W., Mattoon, Ill.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Ford Meter Box Co., Wabash, Ind.
Foundry Mfg. Co., St. Albans, Vt.
McNutt Meter Box Co., Brazil, Ind.
S. E. T. Valve & Hydrant Co., New York.

METER COUPLINGS
*Mueller Mfg. Co., H., Decatur, Ill.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Union Water Meter Co., Worcester, Mass.
Clark Co., H. W., Mattoon, Ill.
Ford Meter Box Co., Wabash, Ind.
McNutt Meter Box Co., Brazil, Ind.

METER TESTERS
*Mueller Mfg. Co., H., Decatur, Ill.
*National Meter Co., New York.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
Buffalo Meter Co., Buffalo, N. Y.
Clark Co., H. W., Mattoon, Ill.
Ford Meter Box Co., Wabash, Ind.

METERS, ELECTRIC
Duncan Elec. Mfg. Co., LaFayette, Ind.
General Electric Co., Schenectady, N. Y.
Sangamo Electric Co., Springfield, Ill.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

METERS, WATER
*Badger Meter Mfg. Co., Milwaukee, Wis.
*Hersey Mfg. Co., Boston, Mass.
*National Meter Co., New York.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
Builders Iron Fdry., Providence, R. I.
Buffalo Meter Co., Buffalo, N. Y.
Gamon Meter Co., Newark, N. J.
Simplex Valve & Meter Co., Philadelphia, Pa.
Thomson Meter Co., Brooklyn, N. Y.
Worthington Pump & Mchy. Corp., New York.

MIXERS, CONCRETE. (See Concrete Mixers.)

MIXERS, GROUT
American Cement Mchy. Co., Keokuk, Ia.
Kent Machine Co., Kent, O.
Lakewood Engineering Co., Cleveland, O.
Union Iron Works, Inc., Hoboken, N. J.

MIXERS, HOT
*Barber Asphalt Paving Co., Philadelphia, Pa.
Austin Machinery Corp'n, Chicago, Ill.
Kent Machine Co., Kent, O.

MIXERS, MORTAR
*Knickerbocker Co., Jackson, Mich.
*Ransome Concrete Machy. Co., Dunellen, N. J.
*Standard Scale & Supply Co., Pittsburgh, Pa.
American Cement Machine Co., Keokuk, Ia.
Austin Machinery Corp'n, Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Construction Machinery Co., Waterloo, Ia.
Kent Machine Co., Kent, O.
Lansing Co., Lansing, Mich.
Lakewood Engineering Co., Cleveland, Ohio.
Smith Co., T. L., Milwaukee, Wis.
Standard Scale & Supply Co., Pittsburgh, Pa.

MOTOR TRUCKS
*Autocar Co., Ardmore, Pa.
*General Motors Truck Co., Pontiac, Mich.
*International Motor Co., New York.
*Tiffin Wagon Co., Tiffin, O.
*White Co., Cleveland, Ohio.
*Winther Motor Truck Co., Kenosha, Wis.
Acason Motor Truck Co., Detroit, Mich.
Acme Motor Truck Co., Cadillac, Mich.
All American Truck Co., Chicago, Ill.
Atterbury Motor Car Co., Buffalo, N. Y.
Bessemer Motor Truck Co., Grove City, Pa.
Brockway Motor Truck Co., Cortland, N. Y.
Clydesdale Motor Truck Co., Clyde, O.
Corbitt Motor Truck Co., Henderson, No. Car.
Denby Motor Truck Co., Detroit, Mich.
Diamond T. Motor Car Co., Chicago, Ill.
Duplex Truck Co., Lansing, Mich.
Federal Motor Truck Co., Detroit, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
Garford Motor Truck Co., Lima, O.
Gary Motor Truck Co., Gary, Ind.
Gramm Bernstein Motor Truck Co., Lima, O.
Indiana Truck Corp'n., Marion, Ind.
Jackson Motors Corp'n., Jackson, Mich.
Kelly Springfield Motor Truck Co., Springfield, O.
Kissel Motor Car Co., Hartford, Wis.
Larrabee-Deyo Motor Tr. Co., Binghamton, N.Y.
Nash Motors Co., Kenosha, Wis.
Nelson Motor Truck Co., Saginaw, Mich.
Packard Motor Car Co., Detroit, Mich.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Republic Motor Truck Co., Alma, Mich.
Rowe Motor Mfg. Co., Lancaster, Pa.
Selden Truck Corp'n, Rochester, N. Y.
Service Motor Truck Co., Wabash, Ind.
Sterling Motor Truck Co., Milwaukee, Wis.
Stewart Motor Corp'n., Buffalo, N. Y.
Titan Motor Truck Co., Milwaukee, Wis.
Traffic Motor Truck Co., St. Louis, Mo.
Transport Truck Co., Mt. Pleasant, Mich.
U. S. Motor Truck Co., Cincinnati, O.
Velie Motors Corpn., Moline, Ill.
Ward LaFrance Truck Co., Elmira, N. Y.
Watson Products Corp'n., Canastota, N. Y.
Wilson Co., J. C., Detroit, Mich.

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Headley Good Roads Co., Philadelphia, Pa.
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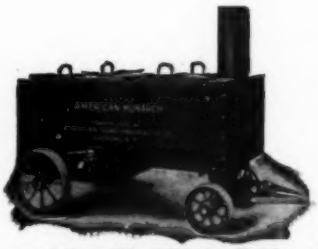

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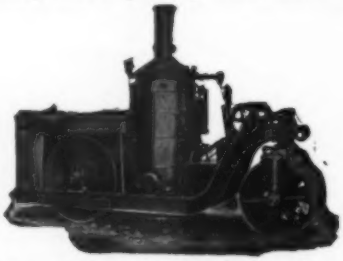

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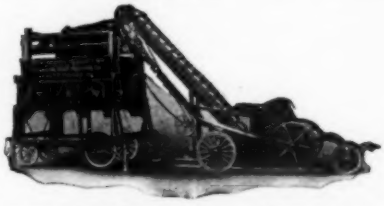

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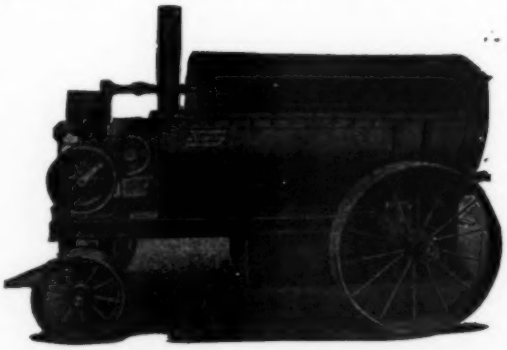

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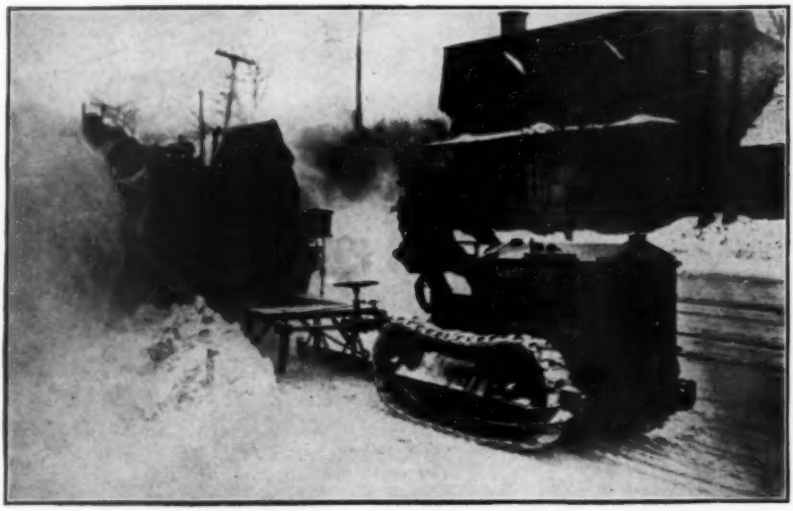

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Vol. III — CONTENTS FOR DECEMBER, 1921 — No. 6

EDITORIAL

Concrete Bridge Construction 41
The Construction of Chicago's Longest Viaduct 42
New Building Contracts Include a School, a Library and Marine Terminals 43
Asphalt in the Paving and Roofing Industries 44
Women in Contracting and Engineering 45
Savings from Little Things 46
Construction Costs—Part I 49
The Responsibility of Builders 53
Creosoted Timber for Heavy Construction 54
A New Model Calculating Machine 55
Highways for Transportation Service 55
The Economic Side of Anti-Siphon Traps in Plumbing Systems 56
A Portable Saw Rig for the Contractor 58
Associated General Contractors—News Notes and Comments 59
What You Want When You Want It 61
Contractors,' Engineers' and Manufacturers' Notes 63
Equipment for Highway, Street and Grading Jobs 64
Taking Stock of the Business Situation 65
Legal Decisions in the Contracting Field 66
Principles of Correct Pipe Threading 67
State Highway Construction Under Federal Highway Act 69
The Conference on the Standardization of Paving Brick 70
Night Lighting by Acetylene Flares 72
Gasoline Shovel in Dangerous Mountain Road Work 73
A Machine for Cutting Out Mortar Before Pointing 74
Activities of Consulting Engineers 74
A Rocking Cableway for Material Handling 76

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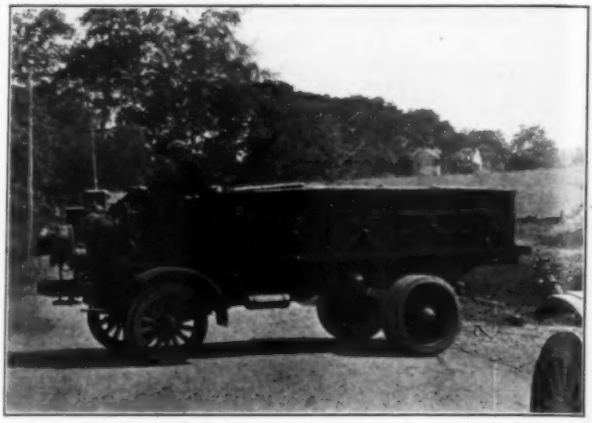

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Concrete Bridge Construction

By Thomas Sheahan

Railroad and General Contractor, Hagerstown, Md.

THE concrete arched bridge illustrated below was built by the writer as contractor for Mahoning and Columbiana Counties, Ohio, from a design furnished by the Ohio State Highway Department. The bridge is near Salem, Ohio, on the Salem-Unity road, which is one of the important east-and-west highways for tourist traffic and makes a much shorter and better road to Pittsburgh than the Lincoln Highway in eastern Ohio and western Pennsylvania. The bridge is a 78-foot span carrying a 24-foot roadway. It is slightly askew. Slag with Beaver River sand and Universal cement with Truscon steel reinforcement was used in the structure. There are about 400 yards of concrete and about 20 tons of steel in the structure. The brick pavement was put on by another contractor under a separate contract.

The design of the concrete arch bridge is something out of the usual, showing that when concrete is properly placed and there is no bulging of the forms and the final surface is rubbed after the forms have been removed, a very attractive-appearing structure can be produced.

On another bridge job also illustrated herewith, the most interesting feature was the reduction of the concrete gang through the extensive use of mechanical equipment. The bridge shown is on the Philadelphia and Reading Railroad at Malino, Pa. It is 148 feet long and carries a 24-foot roadway, consisting of two approach spans and a steel girder concrete encased span. The mechanical plant was so arranged that it was possible to operate it successfully without expensive shut-downs with a crew averaging 8 men.

A 10-ton derrick with an 85-foot boom and an 82-foot mast, equipped with a 1½-yard clam-shell bucket, was used for unloading and storing the sand and crushed stone. A large bin holding 65 cubic yards of stone and 35 cubic yards of sand, with the concrete mixer located in front of the bin and fed by gravity from it, made up a

LEFT—ARCH BRIDGE FOR MAHONING AND COLUMBIANA COUNTIES, OHIO.
RIGHT—PENNSYLVANIA & READING R.R. BRIDGE AT MALINO, OHIO

portion of the plant. The bin was filled each morning in about two hours. The derrick was used to handle the concrete from the mixer to the forms. The bin held enough material to run for 7 hours, a production of 65 cubic yards of concrete. The mixing crew consisted of one hoisting engineer, one mixer operator, one bin man, one man at the forms to dump the derrick bucket, two men spading the forms and placing reinforcing steel, and one foreman. When this crew was not concreting, it assisted the carpenters in building the forms.

The concrete mixer had a 10-cubic-foot capacity, was gasoline-driven and had a power loader which slid under the bin to receive its proper proportions of sand, stone and cement. The cement was unloaded from the freight cars by a chute to a portable cement house, and the mixing plant was located at the door of the cement house, reducing labor. With the use of the large derrick it was possible to store all materials as they arrived, eliminating shut-downs.

The Construction of Chicago's Longest Viaduct

THE Roosevelt Road viaduct in Chicago is one of the most interesting engineering projects of recent years. When completed, it will form the connecting link between two of the busiest districts in the city. It will replace a series of steel bridges and viaducts over the Chicago River and several main-line freight yards.

The problem of how to cast the heavy concrete girders that span several busy freight tracks without interfering with traffic was of first importance. The girder was so heavy that ordinary arch bracing would not hold it, and there was no room for posts to be erected below. This problem was met by hanging the forms from heavy steel girders, such as are seen on railroad bridges. The picture shows how large this girder was, and how closely the supporting rods were spaced.

SECTION OF VIADUCT OVER BUSINESS STREET

Completely Filled Forms Essential

In order to save headroom and to insure absolute safety under any possible load, a large amount of reinforcing was necessary. In places the network of steel bars appeared so intricate that one might well wonder how the concrete could flow through and fill the forms completely. It was essential, of course, that the forms be completely filled so that the full value of the steel might be utilized, and also so that the completed structure would present a well-finished and handsome appearance.

INGENIOUS SYSTEM OF SUPPORTING CONCRETE FORMS OVER BUSY FREIGHT YARD

Hydrated Lime Improves Workability

This was secured by adding five pounds of hydrated lime for every sack of cement used. The hydrated lime added that essential quality of "fatness" to the concrete which made it easy to handle through the long chutes or in the buggies. It spread easily, flowed around the reinforcing smoothly, and filled up the corners in an entirely satisfactory manner. When the forms were taken off the work, there was practically no patching to be done; and moreover, the concrete was of a very pleasing white tone, giving a most attractive appearance to the work.

The structure was designed by the Chicago City Engineering Staff and erected by the city, and is a credit to the city and its engineering forces.

New Building Contracts Include a School, a Library and Marine Terminals

General Description of Some Recent Public Works Contracts

THE general contract for the construction of the Academic Art Building of the R. J. Reynolds High School at Winston-Salem, N. C., has been awarded to the Du Pont Engineering Company, Wilmington, Del. The building is beautifully situated about one mile from the center of Winston-Salem, on the top of a small hill, where there is a commanding view of the surrounding country.

The building was designed by Charles Barton Keen of Philadelphia and will cost $433,000. It is approximately 268x152 feet and is three stories high with the exception of a small portion, which will run to four stories. It is to be constructed on concrete foundations, with face brick backed with tile and trimmed with Indiana limestone. The floors are to be of reinforced concrete covered with composition flooring and linoleum. The power-plant, approximately 50x 70 feet, is to be built at a distance of 300 feet from the high school and is to be connected to this building with an under tunnel for conveying pipe lines.

The Du Pont Engineering Company has also been awarded contracts for the construction of the Marine Terminals at Wilmington, Del., and also of the new Library, which is to be approximately 190x 80 feet and is being erected on the south side of Rodney Square in the very heart of the city. The basement walls will be of granite, and the main building of buff limestone with polychrome terra cotta frieze and crestings. The main book storage will be in the basement, which will be equipped with double-tier steel racks of latest design. These with a few stacks on the first floor will have a capacity of 400,000 volumes. The children's room, 48x72 feet, will be in the basement, the floor of which, on account of the slope of the ground, will be on the street level. Boiler and machine rooms are to be in the sub-basement.

On the first floor will be reading, refer-

THE INITIAL UNIT OF THE NEW MARINE TERMINALS, WILMINGTON, DEL.

ence and magazine rooms, delivery desks and offices. The second floor will be occupied by a lecture room, fine art galleries and rest rooms. The roof is to be of flat concrete construction with necessary skylights for proper lighting. Ground was broken in September, and it is expected that the building will be ready for occupancy within one year. Tilton & Githens of New York are the architects.

The Marine Terminals are designed to give Wilmington a modern port. They are being constructed at the conjunction of the Delaware and Christiana Rivers a few miles above the Delaware Bay. From them there is a direct deep-water route to the sea. The area in which they are built is tapped by the important railroads which afford direct access to the great eastern industrial districts. Unit No. 1, which is now being built by the Du Pont Engineering Company, is a portion of the comprehensive plan which has been developed. It is self-contained and will permit the handling of cargoes of every description and also provide storage facilities for consignment shipments. The designs of the storage buildings and handling facilities are the latest developments in their line, and when completed will be models which will be followed for ports at cities of this size.

The work covered by the present program consists of a reinforced concrete dock 1,200 feet long, which is capable of berthing three ocean-going vessels, a marine cargo shed which consists of wings A and B, a transit shed having a total floor area of 168,000 square feet, and a coastwise cargo shed having a floor area of 6,400 square feet. In addition to these storage buildings, there will be a yard master's office, a barracks and a cafeteria capable of taking care of 175 men. The entire unit will be provided with separate fire and domestic water lines so arranged that river water can be used in case of fire without contaminating the drinking supply. There will be four miles of standard-gage railroad track directly connected to the three railroads and so arranged as to provide ample facilities for prompt handling of freight as well as for open storage of perishable materials awaiting shipments.

On the wharf deck the necessary tracks will be installed for a 50-ton gantry crane as well as for placing cars for direct discharge from ship's hold to cars or from cars to hold. A coal pocket and a crane will be provided so that vessels can be supplied with bunker coal or cargo coal. The entire development, which was started the latter part of August, 1921, will cost $1,750,000 and will be completed and ready for operation by August, 1922.

Asphalt in the Paving and Roofing Industries

ASPHALT is the oldest water-proof adhesive known to man and since its production from petroleum has made it readily available in large quantities it has been adapted for a surprising number of industrial purposes. Of these the paving industry consumes the greatest proportion. The probable consumption of asphalt of 190 penetration and less in pavement construction and maintenance during 1921 has been estimated by J. E. Pennybacker, Secretary of the Asphalt Association, to be about 634,000 tons. To this may be added about 35,000 tons of flux necessary to soften the harder grades to suitable consistency, giving a grand total of 669,000 tons. Allowing 10 per cent for maintenance, this amount will be sufficient to construct about 60,000,000 square yards of asphalt pavement, or on the basis of a 20-foot width over 5,000 miles of such pavement.

In the consumption of the asphalt the roofing industry is a close second to the paving industry and together they consume probably 90 per cent of the entire asphalt output if road oils are not included. The development of the asphalt roofing industry to sizable proportions has been more recent than the paving industry but was given a great impetus during the late war period owing to the enormous demand for ready and prepared roofings. Herbert Abraham, chairman of the Technical Committee of the Prepared Roofing Association, estimates the present annual consumption of asphalt, including flux by the roofing industry, to be about 625,000 tons, equivalent to 28,375,000 squares of roofing. Figuring an average of about 10 squares to a dwelling, this amount is sufficient to cover more than 2,500,000 dwellings or over 280,000,000 square yards of roof.

In addition to paving and roofing there are a large number of industries which in the aggregate consume about 144,000 tons of asphalt. A considerable amount of this is used for waterproofing and flooring and lesser amounts for sheathing and insulating purposes. Asphalt also finds its way into the manufacture of considerable quantities of rubber goods, paints, varnishes, enamels and japans, and such specialties as anti-acid compounds, pipe dips, bituminous putty or cement, emulsions, moulding compositions, electrical insulating products, sealing compounds for storage batteries, wall boards and floor coverings.

In most finished products asphalt is used primarily as a binder or coating for the body of the structure and constitutes but a fraction of the total weight of such products. Its use is therefore dependent upon the consumption of large quantities of other materials, the production of which represents industries dependent to a considerable extent upon the asphalt industry. Thus in pavement construction, considering only that portion of the pavement which is bound together with asphalt, an average of about 8 per cent of asphalt is used to bind 92 per cent of mineral aggregate. This represents an annual consumption of over 8,000,000 tons of broken stone, gravel and sand in pavement construction, including nearly 400,000 tons of pulverized limestone or Portland cement filler. The manufacture of asphalt roofings probably consumes in the neighborhood of 200,000 tons of felt and similar fabrics and 300,000 tons of mineral surfacing such as talc, mica, silica, sand and crushed rock.

Without considering the various material used in asphalt specialties a rough approximation of material annually consumed in the manufacture of asphalt products including pavements would be as follows:

Paving asphalts and fluxes	669,000	tons
Roofing asphalt and fluxes	625,000	"
Asphalt for specialties	144,000	"
Total asphalt, not including road oils	1,438,000	"
Sand, gravel, and crushed rock for paving	8,000,000	"
Mineral surfacing for roofing	300,000	"
Felted and other fabric for roofing	200,000	"
Grand Total	9,938,000	"

Women in Contracting and Engineering

WOMEN are beginning to invade another field of masculine activity in no small numbers. Among those who are quite prominent in the contracting and engineering field is Dr. Jennie C. Murphy, the only woman street commissioner in the world. Dr. Murphy bosses the construction gangs and street cleaners at Yankton, S. D., and has held the job to the entire satisfaction of her constituents and the credit of her city for several years.

As a contractor, Mrs. Axel Holm of South Range, Wis., has just completed four and a half miles of state highway through Pattison State Park, near Superior, Wis., doing a job that would be a credit to any man. The road which she has just completed forms a part of the great Mississippi Valley Scenic Highway from New Orleans to Canada. Mrs. Holm handles the finances of her company, bosses a gang of 57 workmen, cooks their food and looks after the welfare of her machinery and 20 teams of horses. Two daughters, Vivian and Verna, keep her books and assist her in her work. Another "contractress" engaged in road work is Miss Eva Cressey, president and general manager of the Cressey Contracting Company, Everett, Mass. Road machines manufactured by Miss Cressey are used in many states of the union for spraying oil, tar and asphalt in road work. At the present time Miss Cressey has machines working on contracts as far south as Texas, in addition to many others in the East and Middle West.

It was Miss H. M. Berry, of Chapel Hill, N. C., who as secretary of the North Carolina Good Roads Association, did such splendid work in putting over the $50,000,000 bond issue for the new roads now being constructed in North Carolina.

Dr. Lou Alta Melton, who is said to be the only woman bridge engineer in the country, graduated in civil engineering last year from Colorado University and is now connected with one of the district offices of the United States Bureau of Public Roads. She is the only woman engineer in the employ of the Federal Government.

Man, watch out for thy laurels in contracting and engineering!

Savings From Little Things

Salvage Operations in the Miami Conservancy District Are Interesting and Contain Lessons for All Contractors

THE Miami Conservancy District, which is now beginning to close up its affairs and terminate its interesting history, has been remarkable for the large amount of construction work which it has done with its own forces. Besides employing an engineering and construction organization, it has purchased all of the material, equipment and supplies necessary for the prosecution of the work. About half of the District's construction expenditure has been for labor, and the other half has been for materials, equipment and supplies.

The handling of equipment and material on construction work has in the past received careful thought from engineers and contractors. Benefiting by the experience of others, the District was able to establish a satisfactory and economical method of handling these things at the very start of the work. With supplies, however, the general practice in construction work has been to buy, use, throw away, and rebuy. The District, by its new salvage operations, has pioneered to a considerable extent.

Defective Small Articles Promptly Discarded

A big job seems to devour repairs and supplies. A never-ending stream of orders for shovels, rubber boots, padlocks, valves, pipe fittings, steam hose, cable clips, nuts, washers, dowel pins, repair parts and several thousand other articles goes through the purchasing department continually. It is not hard to see the reason for this. An easy way to lose large sums of money is to waste time on defective machinery, so it is very natural that some of the smaller things, such as valves, hose fittings, lubricators, injectors, etc., should be treated with small ceremony when they "go bad." If a $3 valve is caught wasting even a small amount of the precious steam for a $400,000 drag-line excavator, no jury is needed to sentence the culprit. Without ceremony, the long arm of the ever-watchful master mechanic reaches out, and at once a shiny new 100 per cent valve is put on guard and the offender finds itself back in some out-of-the-way corner along with a number of other incompetents with an avoirdupois value only.

It is not unusual on construction work generally, and quite often in manufacturing plants, to pay no attention to the incompetents after they have once failed, except to sell the junk pile every so often to a thrifty junk dealer at so much a pound. Most construction men are strongly opposed to the use of second-hand supplies. They can hardly be blamed for their attitude, as so much second-hand stuff is useless. The use of second-hand supplies often results in a penny-wise and pound-foolish situation.

On a big job like the Conservancy work, the sum of these small items amounts to an astonishingly large total. For instance, about 3,000 valves of 2-inch size or less, with a total value of $10,000, have been purchased since the job started, and 580 axes, 23,550 cable clips, 300 sledge hammers, 900 picks, and other supplies in proportion have been furnished to the job by the central warehouse in small lots. At first everything was new; the plant was being assembled and extended, and the supplies used were mainly for this original installation. But soon replacements had to be made, and the junk piles began to grow.

Superfluous Reservoirs of Supplies

An odd problem came up first, the solution of which paved the way for the exploitation of the junk piles. The work is so big that it has been broken up into divisions, each with a superintendent in charge. Each superintendent is a high-grade man accustomed to being in responsible charge of work, but the District is compact enough so that communication is easy between the divisions, and the work is supervised as a unit with a constant shifting about of equipment, men and supplies between the divisions. At first the superintendent and engineers were not used to this, for jobs as big as this one are very rare. Instead, they had all previously been working a long way from the base of supplies. Being a canny lot, as soon as they had the work well under way they began to horde repair parts,

pipe fittings, special tools, the many things their jobs might or might not need, but would always need in a big hurry if the emergency came. Nothing hurts a superintendent's feelings worse or damages his reputation or his costs more than waiting for repair parts or supplies. So a reservoir of such things soon accumulated at each job, ready for use when the time came.

The amount of money tied up in these reservoirs of supplies became so large that a survey of the situation was made. In some cases special repairs were held in reserve at six or seven of the divisions, when one or two held at headquarters to be rushed out in case of breakdown would have been ample. Jobs fortified themselves against a series of accidents to their steam lines by keeping a considerable number of valves and fittings on hand, when one or two valves and a limited supply of fittings would be enough in the field if a reserve stock were available close at hand.

The Ever-Hungry Big Job

A big job seems to devour repairs and supplies. A never-ending stream of orders for shovels, rubber boots, padlocks, valves, pipe fittings, steam hose, cable clips, nuts, washers, dowel pins, repair parts and several thousand other articles goes through the purchasing department continually. It is not hard to see the reason for this. An easy way to lose large sums of money is to waste time on defective machinery, so it is very natural that some of the smaller things, such as valves, hose fittings, lubricators, injectors, etc., should be treated with small ceremony when they "go bad." If a $3 valve is caught wasting even a small amount of the precious steam for a $400,000 drag-line excavator, no jury is needed to sentence the culprit. Without ceremony, the long arm of the ever-watchful master mechanic reaches out, and at once a shiny new 100 per cent valve is put on guard and the offender finds itself back in some out-of-the-way corner along with a number of other incompetents with an avoirdupois value only.

A campaign was started to get surplus supplies back into the central warehouse. It was a campaign of education largely. At first the superintendents, fortified by their experiences of the past, were inclined to resist the efforts made to separate them from their accumulations, but as soon as they were convinced that the central depot would actually give satisfactory service in emergency cases, and that the cost of their work would be lowered by turning in their surplus stock, they gladly coöperated with headquarters in the round-up of extra supplies. Organization was found necessary. Periodic visits to the different features were made by a man specializing in this work. Being well posted on the needs of the job as a whole, he often spotted an article that could be spared from one division and was badly needed by another. Oftentimes a truck accompanied the collector, and the supplies were brought into headquarters as soon as they were released. By systematically going over the camps, the shops and the jobs themselves, stuff stored in out-of-the-way places and almost forgotten was often turned up and put to work. After a time everyone accepted the innovation as the usual thing, and soon the system was working smoothly and efficiently. While at first the efforts were confined to getting surplus supplies back into the central warehouse, it was not long before a wide variety of articles was being handled, transfers were being arranged between divisions, and swaps of machinery engineered.

Salvaging Usable Material

While all this was going on, the junk piles continued to grow. Despite the precedent long established in construction work, that it does not pay to waste time on anything after it has reached the junk pile, the same organization that was collecting the surplus supplies and handling the equipment transfers collected a few standard articles from the discards about the shops and brought them into the general shop at Dayton. A good, handy mechanic was selected and put to work repairing the different things brought in. A very careful check

was kept on the cost, and the result was so encouraging that the operations were greatly enlarged and a great miscellaneous mass of material was rounded up from the jobs and worked over. Valves were so numerous, and obviously in many cases needed so little attention to make them serviceable again, that they were among the first products of the salvage division.

Then the operations were extended to cover stoves, barrels, air hose, gasoline pumps, boiler flues, rubber boots, wheelbarrows, window sashes, jacks, water pumps, grindstones, chain tongs, oil pumps, dump cars, oil cans, steam gages, valves, cable clips, and many other things. Nothing was too large and nothing was too small for the salvage division to tackle. A cable clip is a small thing, commonly not even detached from the wire rope when the cable is thrown away; yet two men equipped with an automobile and acetylene torch secured 1,693 clips of various sizes from the piles of discarded rope out on the job. The saddles were dipped in paint and new U-bolts were put in, and the rebuilt clips were issued to the job at somewhat less than the new price. The net saving to the District on this one transaction was $438. Very often it was found that by taking three wrecked wheelbarrows, two usable ones could be produced. Discarded stoves were gathered up. Sometimes it took two or three wrecks to make one good stove. At other times the addition of a casting or two and the application of a little stove polish worked wonders.

It was early found that great care was needed to avoid salvaging something that cost more to save than it was worth. Rubber boots are used in large quantities on the District work on account of the sluicing operations. They are useless to the job when they begin to leak. At first glance this looked to be a fertile field for the repair man, but a few trials demonstrated that a reclaimed boot strong enough for the severe usage given it on the pipe gang cost more than a new boot. Great possibilities were seen in turning discarded telephone and telegraph poles into fence posts, but the fence posts produced in this way persisted in costing more than new ones made in the regular way. Wrecking buildings for the lumber they contained often proved to be a delusion and a snare. The policy was early established of carrying out new operations in a small way before plunging extensively, and nothing was worked upon that did not show a definite advantage or saving to the District.

The Actual Money Gain

It was recognized that the junk has a value as junk to the division that has it in its possession. Therefore, the practice has been for the salvage division to take in the articles from the field at about the price they would pay if they were outside dealers, do the repair work and reissue the articles to the job at a figure high enough to cover the price paid to the field plus the cost of repairs. So far about $60,000 worth of material has been salvaged and reissued. This had, of course, a value as junk, which was about $35,000. The cost of reclaiming this, of the overhead, the supplies, and everything, has been about $3,000, leaving a clear gain of about $22,000 from the transactions. All of this gain has been made on little things. The division has grown from one man working only part time to four men working full time. The best results have been secured by centralizing the supervision, conducting the work as a part of headquarters' operations. The engineer in charge has become a specialist.

So successful was the salvage work that it has become very convenient in some cases to repair machinery and to handle a portion of the movement of equipment about the job through the salvage division. At the present time, with the District's work rapidly drawing to a close, equipment and supplies are being released for sale. It has fallen to the salvage division to prepare these articles for sale and to assist in listing and pricing them.

At first the veterans of the construction force took the delvings into the junk pile as a joke. However, they were glad to help and were interested in the experiment. They were glad, also, to receive the substantial credits to the costs of their work that were derived from the rehabilitation of the various down-and-out articles. They were doubtful at first of the quality of the reclaimed stuff, but after a few trials they were convinced of its utility. It was early found that a careful cleaning and the application of a little paint greatly aided in convincing the construction men that the second-hand articles which had been salvaged were "as good as new."

Construction Costs—Part I

By W. N. Connor

Chief Cost Accountant, Aberthaw Construction Company, Boston, Mass.

THERE have been many books, pamphlets and papers published on cost accounting, but very few dealing with its application to construction work. One reason for this is that so few contractors keep a thoroughly accurate check on their costs or maintain a standard cost system. A majority rely on their bookkeeping departments to furnish them cost data. This, to my mind, is doubtful practice, as a bookkeeper deals in absolutely accurate figures down to a penny, while the cost accountant's view-point is somewhat more liberal.

I do not mean by this that the cost accountant's figures need not check with the bookkeeper's ledger, for they must; but the training of the bookkeeper is such that he will naturally figure his costs in the same manner as he keeps his accounts, and thereby often lose the sense of proportion of costs. Costs are really tied up just as closely with the engineering and estimating departments as with the accounting department. The cost accountant should understand the physical side and be able to visualize the work itself—a thing which a bookkeeper is not trained to do.

In the introduction to the book "How to Find Factory Costs," by C. B. Thompson, occurs the following:

"The Federal Trade Commission has called attention to the fact that less than 20 per cent of the business concerns in this country have a cost system, and that a large proportion of the many failures recorded every year is due to the absence of an accurate knowledge of what it costs to manufacture and sell. The Commission is urging every business man to take this first step in the development of that primary effectiveness by means of which alone this country can be brought to an appropriate degree of industrial preparedness."

Mr. Thompson also says:

"The chief distinction between financial accounting and cost accounting is that the former deals exclusively with the money and credit transactions of a business, while the latter deals with these same transactions but with reference to the cost of products and operations. The unit of financial accounting is the unit of money, whether the dollar, the pound, or the franc, while the units of cost accounting are the units of *money plus the units of operations*, of sales, of product and of time."

What Is Cost Accounting Worth?

On a large job in the South, last summer, the labor overrun was steadily increasing, and a detailed study of the costs was made. It was found that 60 per cent of the overrun was in the form work, and further, that 80 per cent of this 60 per cent was in two items. You can readily see that this gave to the management a big advantage in showing them what to concentrate on. This they did, with the result that many thousands of dollars were saved, and the curve showing the overrun flattened out and remained practically so during the remainder of the work.

The three functions of any cost accounting system are:

1. To aid in assuring the economical handling of the work while it is in progress
2. To obtain figures to compare with the estimate
3. To supply data for use in estimating future work

These are given in order of their importance.

Costs must be available at once to be effective in aiding economical handling of the work. Delayed reports of costs are practically useless in effecting any savings while the work is in progress. Proper cost reports have been compared to a fire-alarm system, in that they should not alone be able to give notice of some unusual condition, but equally lead the investigation to the seat of the trouble.

Each morning the labor costs of the previous day should be known. This is not necessary or feasible on all items of work, but on such as concrete, excavation, brick-

work, etc., it is possible and extremely important that the superintendent of a job should know the daily labor unit costs. If he has them, he can take up with the foremen at once any variations between estimates and actual performance, and endeavor to equalize disproportionate costs of any unit before it is too late. Prompt cost reports enable him to comment intelligently on various items before they become past history, and to be certain that both he and his foremen understand just what constitutes matters of major importance from the cost standpoint.

Only the direct labor on any operation should be included in these cost figures: that is, plant, overhead, etc., should be reported separately and not included with the direct labor charges.

By regular comparison between the actual costs obtained and the estimate, and by means of comparative statements made weekly and monthly, overruns or savings on the estimate may be discussed with the owner at once and he may be kept informed as to just how the job stands financially. This is particularly important on percentage work, as it permits the contractor and the owner to get together and talk over the progress of costs, and, if necessary, to make intelligent changes of plan while the work is under complete control and the financial bearing of changes is understood.

It used to be the custom, and I'm afraid it is yet in a good many companies, to regard costs as something to be kept secret and locked up tight, never letting the foreman know what his costs were, but always suggesting that they were excessive. How can a man be held responsible for his costs unless he is given full information regarding them while his work is in progress? And what makes for better work and loyalty then telling a man when his costs are good and commending him for the fact?

A few years ago a paper was read before the Boston Society of Civil Engineers entitled, "Cost Accounting on Construction Work." This well-written pamphlet explained fully the system then used by the Aberthaw Construction Company for keeping costs. Since then, some changes have been made, the principal ones consisting of a change of forms, the placing of actual tabulating of the costs with the job, and the establishing of a separate cost accounting department, where before cost accounting had been a function of the estimating department.

Labor Costs

1. *Summary of Estimate.*—At the start of a job an estimate is made in the usual manner. This shows the actual take-off from the plans, with the items, quantities, units and amounts. These units include the labor, material, overhead and plant costs.

2. *Analysis of Estimate—Labor.*—This estimate is then split into a labor and a material analysis. In the labor analysis these various items will show only the direct labor, with plant labor and overhead separated.

Opposite each item in the labor analysis is shown the symbol under which the working time is to be reported. This analysis is sent to the job, where it becomes the standard for labor cost comparisons on all operations of the job, and the estimate is not referred to.

One can readily see that, by separating labor and material, the work for the job superintendent in following his costs has been made much easier. He knows by the labor analysis just what figure the Estimating Department has set for the unit on each item. He is able to study his labor costs without being obliged to figure out his material, for the cost of which he is very often not responsible, as a great deal of the purchasing may have been done at the home office. He has condensed for him now those units for which he is responsible. If he thinks any of them too low, he can take up the case at once with the Estimating Department—and I must confess that this is done quite often.

3. *Timekeeping Symbols.*—Most contractors use a series of numbers for reporting their labor operations, but Aberthaw uses a mnenomic code.

In the Aberthaw system the first letter is always a capital and indicates the kind of work to be done. For instance,

F stands for Forms,
R for Reinforcement,
B for Brick,
D for Digging, etc.,

in so far as possible the first letter of the item represented being used. The second letter is always a vowel and explains the class of the work.

a stands for making items,
e for erecting or setting up,
i for tearing down or dismantling,
o for repairing,
u for unloading.

The third letter, which is always a con-

sonant, indicates the part of the building in which the work is being executed, as—

f floor,
w walls,
c columns,
s stairs.

As the code is the same on all jobs, our timekeepers and cost men quickly adapt themselves to any requirements of the work. If some work comes up not included in the code, a timekeeper can very quickly make up his symbol to cover it, and it can usually be interpreted by the cost man. If necessary, an explanation may be written opposite the item the first time it is reported.

A real feature of this code is the manner in which it helps visualize the work. For instance, with numbers one might have 21.1 as a symbol for erecting brick walls. How much better is the symbol Bew—"B" brick, "e" erect, "w" walls.

4. *Timekeeper's Field Sheet.*—To report the time and distribution of the men, the timekeeper uses a field sheet which shows each man's number in the left-hand column.

These sheets are in two series, one running from 0 to 50, and the other from 51 to 100, and the numbers are printed on the sheets, so that if a job has a series of checks numbered from 1,200 on, the timekeeper needs only to write in the number 12. The next columns show the time at which the men reported for work and the time at which they quit work.

Tfien there are eleven columns, each one representing one hour's work, and headed 7—8, 8—9, 9—10, etc., up to 5—6. In these spaces, after each man's number is written the symbol for the type of work performed. If one man is erecting forms from 7 to 12 continuously, the symbol "Fef" would appear in the first hour column and a dash in each succeeding column up to 12 o'clock. Then he might change and work at erecting wall forms to 5 o'clock. In such case the symbol "Few" would show. The timekeeper makes four checks a day, and if the men have changed their class of work between checks, he confers with their foremen as to the hour when changes have been made. The remaining columns show the rate, then the amount earned and the actual hours worked divided into regular and overtime.

We have, therefore, on this timekeeper's field sheet a complete record of each man's daily time and class of work performed.

This field sheet is the same length and ruled the same as is the pay-roll sheet. We can, therefore, in transferring the time from this field sheet to our pay-roll, simply lay it down on the pay-roll sheet and copy the figures on the lines which coincide. This offers a great saving of time and is much more accurate than calling the time off, or transferring it by comparing the men's numbers.

The type of ruling on forms is a very important item. Those forms which are to be used together should be, in so far as possible, ruled similarly. This fact, I believe, is not usually given the emphasis that it deserves.

5. *Waste Sheet.*—The office cost man, with the timekeeper's field sheets before him, now uses a sheet which is called a "Waste Sheet." He combines all the "Fef," "Med," "Ref," etc., symbols of the field sheet and figures the total daily expenditure under each symbol. These amounts he enters each in a column headed with its proper symbol. The total should check with the total daily pay-roll.

This sheet is ruled for seven days. It is kept up to date daily, so that at the end of the week the cost man has the total weekly expenditure for all the symbols under which work has been performed. The quantity man gives him the quantity of work accomplished, which he enters under the total weekly cost of the "Waste Sheet" and then figures the unit cost and writes that under the quantity. He then has under each symbol the total weekly expenditure, weekly quantity, and weekly unit.

6. *Labor Cost Record.*—The next step is to transfer these items to the Unit Cost Record Book. This is a loose-leaf, I. P. ring binder, carrying a sheet for each symbol. The first column of the sheet shows the date of the week ending; the second, the weekly cost; the third, the weekly quantity; and the fourth, the weekly unit. These items take up about one-half the sheet. The other half shows the cost to date, quantity to date, and unit to date. As a partial check on these items, there are included two columns, one for number of barrels of cement used, and one for cubic feet of concrete per barrel. At the top of the sheet, directly over the quantity, amount and unit to date column, is a space to write in the estimated quantity, amount and unit, so that these estimated figures can be compared with the actual figures at any time.

This is kept up to date each week, and is checked against the total pay-roll of the job. This book is the permanent record of the labor costs and is sent to the home office at the completion of the job.

7. *Labor Cost Statement.*—We are now ready to make out the Weekly Labor Cost Statement. In this, first the symbol is shown, then the kind of work; next, the weekly cost and weekly unit. Succeeding columns offer a detailed comparison with the Analysis of Estimate, the estimated quantity unit and cost being set against the actual quantity and unit and cost attained in operation. The last two columns give opposite each item, in one case, the overrun; in the other, the saving.

As an illustration:

Suppose we have listed in our analysis of estimate 1,000 cubic yards of concrete under the symbol "Med," at a unit cost of $1.50 per cubic yard. By the fifth week of the job there has been completed 700 cubic yards at a unit cost of $2.00 per cubic yard. Seven hundred cubic yards at $1.50 would be $1,050, which would have been the expenditure on that item, provided the work had been done at the estimated unit of $1.50. But actual cost is $2.00 per cubic yard, which means an expenditure of $1,400, or an overrun of $350 on this item. If it had been done for a unit of $1.00, there would have been a saving of 50 cents per cubic yard, or a total saving to date of $350. Each item is figured out similarly, and the difference between the saving and the overrun is shown in the proper column.

For those items on which no quantity is reported, as plant, watchman, overhead, etc., a percentage is used. For example, if $1,000 is allowed for overhead and the job is to last ten weeks, this overhead will average $100 per week. If, after the job has gone six weeks and $700 has been expended, and it is figured that $450 more will be expended, the overrun will be $150; and this is shown.

The labor cost sheet gives the costs in detail for the job superintendent to study, and informs him just where he should concentrate and what he should study. If 75 per cent of his total overrun is in two items, the place for him to remedy his high units is clear. Without some such data how can a superintendent intelligently talk to his foremen or know his job?

8. *Labor Comparison.*—In order to condense this report for the management, a comparison of savings and overruns is made, listed under the various symbols. All the overruns or savings on one class of work are totaled, and the total overrun or saving shown as concrete, forms, reinforcement, etc. The record of the previous week is also shown so it may be compared with that of the current week.

The Labor Cost Statement, together with this labor comparison sheet attached, is sent into the main office each week so as to reach there not later than the Monday morning following the closing of the pay-roll. One copy goes to the general superintendent and one to the Cost Department.

9. *Pay-Roll Sheet.*—The pay-roll sheet is ruled for seven days, with two columns for each day, one to show regular and the other overtime hours. The regular and overtime hours are extended and shown in separate total columns, as also is the regular and overtime rate, the total amount earned for the week being in the next column.

The man's name and number appear in the extreme right-hand column. This, I think, is rather unusual, but we find it much better when paying off, as the person paying need only look at the next column and not from one side of the sheet to the other to check the name and amount, which lessens the danger of errors considerably.

So much for the labor cost records. Their handling is so standardized that we can transfer our cost men, if necessary, to any job, and they can readily pick up another timekeeper's or cost man's duties.

ACKNOWLEGMENT.—Reprinted from the *Journal* of the Boston Society of Civil Engineers.

Part II, "Material Costs," will appear in the January issue of the CONTRACTORS' AND ENGINEERS' MONTHLY.

Who Makes Sand and Gravel Screens?

Frequently you are confronted with the question of who makes a specific kind of equipment. By consulting the "Where to Purchase" directory beginning on page 3 of the CONTRACTORS' AND ENGINEERS' MONTHLY your query is quickly answered.

The Responsibility of Builders

Brooklyn Disaster Typical of Lack of Proper Placing of Responsibility

THE unanimous chorus of self-exoneration which came from every party connected in one way or another with the building of the American Theater, which recently collapsed in Brooklyn, N. Y., shows that there has been a definite failure in placing the responsibility for weakness of structures. The owner, the architect, the general and special contractors, the city inspector, all say that they have done their full duty or that the construction was in full accord with the standard of the art, or that every law and ordinance was obeyed.

The *New York Times* states: "The fact remains, however, that while the building that soon was to be a gathering place for crowds of people still was some distance from completion, the greater part of it toppled with a great crash to the ground. None of the pleas made can contradict that fact, and unless there is nobody who knows how to put up a steel frame building in such a way that it will stand firm during and after construction, then somebody was guilty of criminal negligence or of ignorance usually held to be hardly less criminal."

In this particular instance the owners were also the chief contractors, so that there could have been no motive on their part either for bad planning or for failure to meet the full requirements of the specifications. They were considerably less likely than others might have been to take known risks for the sake of saving money or of making illicit profits, and they were at least as likely as anyone else would have been to watch the subcontractors and see to it that their work was well done.

Whether or not they observed the common rules of computing the beams and girders and walls and then allowing a proper factor of safety, will undoubtedly be disclosed in some one or more of the several investigations which are under way. The recognized need for a sufficient factor of safety makes the layman feel that there is a great possibility of undiscovered and undiscoverable imperfections in design and materials. The fact that a large factor of safety is applied by dependable designers

Photo by International News

THE RUINS OF THE AMERICAN THEATER, BROOKLYN, DURING THE SEARCH FOR BODIES

does not, however, diminish the need of zeal of building officials, whose task it is to check up all designs and in cases such as the unfortunate Brooklyn disaster to fix the responsibility for any accidents due to lack of proper precautions.

Creosoted Timber for Heavy Construction

Length of Life of Creosoted Timber Brings Federal Approval for Its Use in Bridges

IN January, 1921, the Bureau of Public Roads issued instructions to its district engineers that as the abnormal conditions which existed during the war and which affected all construction and transportation had practically ceased, the policy which had during the war favored the use of timber for bridge construction should be discontinued. This did not absolutely prohibit the construction of substantial wooden structures, but in general it was considered that the building of permanent waterways should be one of the first essentials in the building of substantial highways, and where roads were of sufficient importance to justify the use of Federal Aid funds it was presumed that the traffic in general would be sufficient to make the up-keep of wooden bridges expensive and their construction poor economy.

In September, 1921, these instructions were rescinded in part, inasmuch as they made no distinction between treated and plain timbers. The economic advantages of trestle construction in some sections of the country are so clear and local timber supplies are sometimes available on such terms as to make it advantageous to use timber for long bridge approaches across river-bottoms or for swamp and marsh crossings. Because of this, the Bureau of Public Roads has decided not to question the use of creosoted materials where the following conditions are observed:

A SUBSTANTIAL HIGHWAY BRIDGE CONSTRUCTED OF CREOSOTED MATERIAL

(a) Timber trestles or bridges constructed of creosoted material treated by the vacuum and pressure method

(b) Timber floors constructed of creosoted planking treated by the vacuum and pressure method, laid laterally with a plain or tank-treated wearing floor ("half sole") or laid laterally or longitudinally on edge, spiked together and covered with a mastic wearing course

(c) Timber floors, for light traffic where single floors are laid and not protected by any covering, constructed of tan-treated mate-

rial or plain material, depending on whether plain timber is more likely to rot out or wear out.

The instructions as sent out by P. St. J. Wilson, Chief Engineer, U. S. Bureau of Public Roads, states that the instructions are not to be construed as an endorsement of this type and construction or to let down bars to its general use, but to define procedure where conditions of traffic and economy require consideration of timber construction.

For permanence and low cost, well-creosoted timber for construction purposes deserves important consideration. Its use for highway construction includes piling, bridge timbers, cribbing, posts, culverts and other miscellaneous uses, and the saving made possible by using this class of material frequently makes additional funds available for building and maintenance purposes.

ACKNOWLEDGMENT.—Illustration by courtesy of Service Bureau, American Wood Preservers Association, 1146 Otis Building, Chicago, Ill.

A New Model Calculating Machine

CONTRACTORS and engineers having a large amount of figuring to do in design and estimating will be interested to learn that the Monroe Calculating Machine Company, Orange, N. J., has just brought out a new model calculating machine to be made up in three sizes, of 12-, 16- and 20-place capacity. The keyboard of this machine is sloped at a proper angle and the key stems are of uniform height, making it easy to span a set-up. A light touch of the fingers on the keys places the numbers on the keyboard.

The numbers set up are recorded by an easy flexible crank operation with one turn either backward or forward. On the new machine the operating crank is removable, thus protecting the work when interrupted. This is accomplished by a quarter-turn of the crank and a forward movement of the small lever just above the non-repeat key, which releases the crank readily; then no one can use the machine or change the figure while the operator is absent. The crank is easily slipped into place and the work may be taken up just where it was stopped.

When the work is done and the answer noted, no time is wasted in clearing the machine. A reverse turn of the small clear-out crank raises the carriage and clears the dials simultaneously. A forward turn clears the upper dials. The

CONTRACTORS CAN COMPUTE WITH GREATER RAPIDITY WITH THIS MACHINE

operating parts of the new Monroe are few and simple. The repeat key is depressed when it is desired to retain numbers on the keyboard, and the non-repeat key when it is desired to release them at each turn of the crank. They are conveniently located at the right of the keyboard. Depressing one automatically releases the other.

Highways for Transportation Service

COUNTY or state highway departments should not exist merely to design and build a few miles of highway and a few culverts and bridges. They should exist to give transportation service to their clients. They should strive to arrange the laws and their practice so as to give it *now*, not in 1950. The thing which we should strive to serve is highway traffic; we should be purveyors of transportation to His Majesty, the American people.

Traffic must be served!

The people are commencing to demand results rather than higher economics. They don't know much about pavement economics or relative economy of types, but they know when and where they were stuck in the mud and where they broke that last spring.

ACKNOWLEDGMENT.—From an address by A. R. Hirst, State Highway Engineer of Wisconsin, before the American Association of State Highway officials, at Washington, D. C., December 14, 1920.

The Economic Side of Anti-Siphon Traps in Plumbing Systems

By A. E. Hansen
Hydraulic and Sanitary Engineer, New York

CONSIDERABLE attention has been centered of late on the possibilities of reducing the cost of plumbing installations, and the theory has been frequently advanced that the use of anti-siphon traps would obviate the back venting now required by plumbing codes whenever ½ S or bent tube traps are installed, and that a material saving in cost of plumbing work would result.

It is not the purpose of this article to dwell in any way on the scientific principles which underlie the merits or defects of unvented anti-siphon traps, nor to compare their efficiency or usefulness from a technical view-point with that of the vented bent tube traps, but it is the purpose to limit it entirely to the economic side of the question.

Perhaps the most recent typical example of a statement made publicly concerning the economy resulting from the use of anti-siphon traps, occurred during May, 1921, when testimony was given by a builder before Samuel Untermyer, Chief Counsel for the Lockwood New York State Housing Investigating Committee, to the effect that the installation of approved anti-siphon traps in a certain New York City building project would have reduced the cost of the plumbing installation about 50 per cent below that of the vented ½ S trap system.

That the witness was thoroughly misinformed on the subject of his testimony will be clear to any one who reflects on the fact that the cost of the plumbing fixtures—that is, the water-closets, urinals, slop-sinks, wash-basins, bathtubs, kitchen sinks, and wash-tubs, of the hot and cold water-supply pipes and fittings, and of the soil and waste pipe systems remains the same whether anti-siphon traps or ½ S traps with vents are used. The total cost of these items is from 90 to 98 per cent of the cost of the entire plumbing job. Furthermore, under the New York City Plumbing Code requirements, all water-closets must be back vented, there being no approved deep seal fixtures of this kind on the market. A separate vent stack would have to be installed, and therefore the only actual saving by the use of anti-siphon traps would be the short vent branches from the fixtures (other than water-closets) to the vent stack.

In order to satisfy myself on the real economy, if any, of anti-siphon traps as compared with ½ S vented traps, I prepared a plumbing diagram of a typical three-story apartment house, reproduced herewith, which shows in full lines the soil, waste, and vent pipes required by the New York City Plumbing Code, if the approved anti-siphon trap is installed for all the fixtures (exclusive of the water-closets). In dotted lines are shown the additional vent pipes required if the ½ S vented traps are used. I submitted this diagram to three responsible New York master plumbers, with the request that they estimate the costs of the ½ S traps and their vent branches as shown in dotted lines, and also of the anti-siphon traps without vents, as permissible under the New York City Code. I asked them further to consult with each other, and to present to me, if possible, joint estimates which they would consider fair. These estimates were as follows:

UNVENTED PATENTED TRAPS

Patented		
6—1½-inch traps at $ 7.00	$42.00	
3—2- inch traps at 11.00	33.00	
Total cost	75.00	
plus 10 per cent profit.	7.50	$82.50

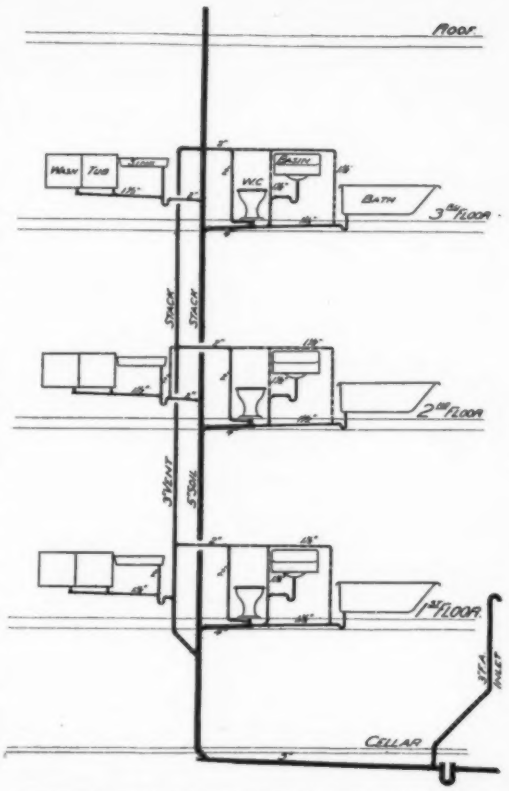
VENTED ½ S TRAPS

24 feet—1½-inch galv. pipe at $.18	$ 4.32	
9—1½-inch galv. mall. fittings at $.30	2.70	
6—1½-inch brass ½ S traps at $1.30	7.80	
3—2-inch brass ½ S traps at $2.50	7.50	
1 day labor.....	10.00	
Total cost	$32.32	
plus 10 per cent profit	3.23	$35.55
Excess cost of unvented patented traps over vented ½ S traps		$46.95

The estimates, it will be observed, show that the actual cost of the vented ½ S traps to the owner, including a 10 per cent plumbers' profit, which I asked to have included, is about $50 less than that of the unvented traps. I believe that the estimates are in-

tended to be proper and are deserving of confidence. Assuming, however, that the labor item of the vented ½ S traps had been 200 per cent underestimated, there would still remain a balance of $25 in favor of the vented ½ S traps.

An analysis of the estimates of cost made by the plumbing contractors indicates that the materials required are correctly inventoried and priced, and that the labor to be performed consists of measuring and cutting 14 pieces of 1½-inch galvanized iron pipe to lengths not exceeding 3 feet; of cutting 28 1½-inch pipe threads, and of installing 14 pieces of 1½-inch pipe and nine 1½-inch fittings. The measuring and cutting should reasonably consume not over ¼-hour each, or 3½ hours total; the cutting of 28 threads not over 1/7-hour each, or 4 hours total; the installation of 14 pieces and 9 fittings not over ⅓-hour each, or 8 hours total. My own estimate of the total labor required would therefore be 15½ hours, or, say, 2 days, instead of 1 day, or $20 instead of $10; but even under this condition the ½ S vented traps are about $36 cheaper than the unvented anti-siphon traps.



PLUMBING PLAN FOR TYPICAL 3-STORY APARTMENT HOUSE

If the number of floors were increased, or the number of apartments per floor multiplied, each requiring a similar typical plumbing installation, this difference would, of course, become correspondingly greater. It is evident that the greater cost of the unvented anti-siphon traps is largely due to the high cost of the traps themselves. Seven dollars for a 1½-inch and $11 dollars for a 2-inch trap are big prices, which seem unwarranted except on the ground of patent or other fees.

From the representative example given, it is fair to conclude that the much-voiced opinion on the invariably lesser cost of unvented anti-siphon traps is not based on actual facts; there are, no doubt, certain individual cases, especially in alteration work or in small dwellings, in which this opinion will be found to be true, but the evidence shows, particularly where the plumbing is condensed near the vertical stacks and where toilet or bathrooms are located repeatedly alike and directly over each other, as is usually the case in apartment buildings, hotels, and office buildings, that the ½ S vented traps are as cheap and perhaps cheaper than unvented expensive anti-siphon traps. It must be borne in mind in this connection also, that patented articles are unlimited in price and not subject to competition, especially where, as at present in New York City, only one such article is approved for use.

The chief item of cost in a back venting system is involved in the venting of water-closets, which are not made with anti-siphon traps; these must be back vented in any case, according to most of the plumbing codes.

The only additional vent pipes required, therefore, for the other plumbing fixtures consist of the short 1½-inch and 2-inch branches which connect the individual traps to the main vent stack or to the water-closet vent branch.

A Portable Saw Rig for the Building Contractor

WHETHER a contractor operates on a small or a large scale, a portable saw rig is one of his necessary pieces of equipment, particularly when he is working on concrete construction or in general building construction.

The portable saw rigs made by the Oshkosh Manufacturing Company, Oshkosh, Wis., are of two types, the first being designed principally for the building contractor and retail lumber yards, while the second is designed for

HANDLING FINER WORK IN A CABINET SHOP IN RICHMOND, VA.

USED AS A PORTABLE MILL AT MARCUS, IA.

jobs where there is a great deal of ripping and cross-cutting.

The rigs are capable of twelve different operations, as follows: rip-saws, cross-cuts, bores, joints, tenons, sands, mortises, band-saws, rabbets, dadoes, grinds and mitres. It is designed as an all-round tool on the job or in the shop. With it can be made all frames, sash, finish, etc., as well as a multitude of parts ordinarily bought of a mill, this being in addition to rip and cross-cut sawing. The portable saw rig does away with hand sawing and cuts labor cost to one-fifth, leaving expensive hand labor free to perform tasks impossible of accomplishment on any machine.

Around a lumber yard it is extremely valuable, being a complete mill in itself. The dealer can furnish builders with finished stock that otherwise would have to be sent to a mill to be worked. On the single operation of trimming and edging broken and low-grade stock it will save its cost in a surprisingly short time.

DOING GOOD SERVICE IN A SHOP AT GALESBURG, ILL.

A SAW RIG ON CONSTRUCTION WORK AT WYOLA, MINN.

All these rigs are equipped with either gasoline engine, electric motor or countershafts for separate power, or no power. All gasoline engines used are made by the Fuller & Johnson Manufacturing Company, and are reliable and efficient. They are all equipped with both magneto and battery ignition less the batteries. The electric motors used are supplied by any of the large manufacturers of standard motors.

The Growth of Street Paving in Akron

. Akron street pavements have been almost doubled during the past ten years. At the present time the city has 144 miles of paved streets. During the past ten years 76.85 miles were paved. A large amount of paving is being done this year, together with more than six miles of resurfacing. The paving record for the past ten years is as follows: 1911, 8.91 miles; 1912, 12.08; 1913, 15.75; 1914, 12.02; 1915, 5.03; 1916, 0; 1917, 5.94; 1918, 5.45; 1919, 6.12, and 1920, 5.55.

ASSOCIATED GENERAL CONTRACTORS
NEWS NOTES AND COMMENTS

Ideals to Be Emphasized at Annual Meeting

W. O. WINSTON, President of the A. G. C., at a meeting in Omaha, Nebr., to consider the relationship of construction to unemployment, made some very interesting and valuable remarks regarding the activities and endeavors of the A. G. C., as follows:

"The Association will work in the public interest just as much as it will work in the interest of its members. It will, in coöperation with architectural and engineering societies, bring about a standardization of building codes. In this and many other ways it will be instrumental in eliminating waste in construction. Eliminating waste cheapens construction; cheapening construction increases construction; increasing construction makes more work for contractors—and there you have it in brief.

"Just two other things that I wish particularly to emphasize: First, our Association is in no way directly or indirectly a price-fixing one. It couldn't be if it would be, and it shouldn't be if it could be. And lastly, from the time of Caesar to the present, construction has been one of the greatest and most important of essential industries, and yet, not until now has construction, broadly speaking, had a seat in the Nation's business council; not until now has construction had a place on the Nation's business map. That it has that seat and that place now, you and I must thank the Associated General Contractors of America."

Third Annual Meeting

What the A. G. C. has done in 1921 and will do in 1922 for building, highway, railroad and public works contractors, will be the chief topic for discussion at the general sessions of the annual meeting, to be held at the Winton Hotel, Cleveland, Ohio, January 17-19, 1922. The annual meeting of the A. G. C. is not the usual type of cut-and-dried speech-making, but more an open conference of the leading contractors of the country for the discussion of the chief problems of the industry.

The first day will be devoted to the annual reports to be submitted by chairmen of the standing committees, giving a view of the work of the Association for the past year.

The section meetings on the second day will be devoted to what the Association can do for different groups of contractors. This will afford an opportunity for a searching review of the actual accomplishments of the Association and an open discussion of its future course. The views of members as to the manner in which the Association can best serve general contractors and the construction industry will be welcomed and recorded. Recommendations as to specific actions may be submitted in the form of resolutions and will be acted upon by the delegates.

Some of the specific subjects which have been listed for consideration include: standard forms of contracts for builders; quantity survey and payment for estimating; National Conference Board in the building industry; costs of building; fall letting of highway contracts; paper profits in highway construction; the middleman; standardization of hard-surfaced highways; future of railroad construction; station men in railroad construction; the scope of the railroad contractor's work; standardization of public works contracts; relief from losses on war contracts; and public work in relation to unemployment conditions.

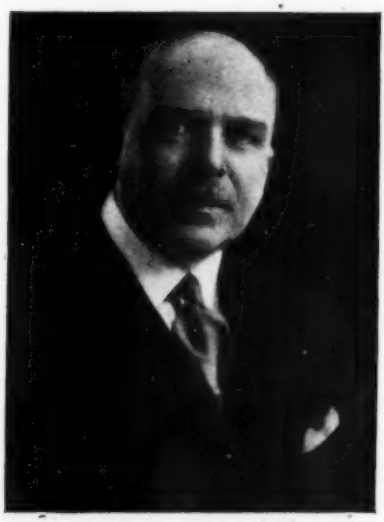
A. G. C. Biographies

Colonel William A. Starrett, Vice-President of the George A. Fuller Company, New York City, was born in Lawrence, Kans., in 1877, and started working in a grocery house in Chicago when very young. Having an interest in construction, he was led to study civil engineering at the University of Michigan and, although he was forced to leave for financial reasons after

COLONEL WILLIAM A. STARRETT

two years, he became such a good builder that in 1917 he was awarded the degree of B. S. in C. E. by his Alma Mater. His first real job was with the George A. Fuller Company, in 1897, when he worked in various capacities until 1900, when he joined his brothers in forming the Thompson-Starrett Company and later the firm of Starrett and Van Vleek, architects. Just before the war he entered Plattsburg, where he qualified as a major in the Engineer Officers' Reserve Corps. When the war came he was called at once and assigned to the War Industrial Board, charged with overseeing all army construction work for the Emergency Construction Section, and in eighteen months he directed the expenditure of a billion dollars' worth of construction. Before the war was over, Major Starrett became Colonel Starrett. He is a member of the American Society of Civil Engineers and the American Society of Mechanical Engineers, and is now back with the first firm he worked for, as Vice-President.

James O. Heyworth, Engineer and General Contractor, Chicago, Ill., graduated from Yale with A. B. in 1888. He decided to become a contractor, and was big enough to start at the bottom as water-boy on a railroad construction job. He learned the business quickly, which is obvious from the fact that he planned and built the old Chicago Coliseum in 1894, becoming also its president and general manager. For six years he was a member of the contracting firm of Christie, Lowe & Heyworth of Chicago, but since 1903 has "gone it alone." One of his first jobs was the erection of the Winton Building, the first reinforced concrete structure to be erected in Chicago. Since then his work has been very extensive and varied, comprising jetties, railroads, bridges, dams, and especially hydro-electric plants. From 1917 to 1919 he served as a member of the staff of the U. S. Shipping Board in charge of wood ship production. Associated with some other men, he invented a drag-line excavator and developed it to very large sizes capable of handling heavy excavating work at reduced costs. Besides his active engineering work, Mr. Heyworth is also very much interested in banking and manufacturing and in several clubs and societies.



JAMES O. HEYWORTH

Annual Meeting, Associated General Contractors, Winton Hotel, Cleveland, Ohio, January 17-19, 1922

WHAT YOU WANT WHEN YOU WANT IT!

The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

TAR AND ASPHALT HEATERS
The bulletins and specifications issued by Connery & Co., 4000 North Second St., Philadelphia, Pa., describe in detail its complete line of unleakable tar and asphalt heaters from 10 to 1,000 gallons capacity.

SCREWS—BOLTS—NUTS
The 80-page illustrated catalog of the St. Louis Screw Co., St. Louis, Mo., contains a complete listing of bolts, bar iron, nuts, screws, washers and other articles used by contractors.

AN ALL-ROUND FLOORING
The new catalog of the Stedman Products Co., South Braintree, Mass., contains colored illustrations and details of Stedman Naturized flooring for industrial and factory flooring, stair-treads, etc.

STURDY PORTABLE CONCRETE MIXERS
The Knickerbocker Co., 338 Liberty St., Jackson, Mich., will send to interested contractors its catalog describing the Wolverine concrete mixer of special design to insure strength and portability.

ROAD MAKING WITH TRACTORS
The versatility of the gasoline caterpillar tractor in handling all kinds of road machinery is described in detail in the literature of the Holt Manufacturing Co., Inc., Peoria, Ill.

EXPANSION JOINTS FOR ROOFS OR ROADS
Philip Carey Co., 9 Wayne Ave., Lockland, Cincinnati, Ohio, manufacturer of Carey Elastite expansion joints, publishes an interesting series of bulletins on the adaptability of this practical joint for roads, sidewalks, bridges or concrete roofs.

GASOLINE INDUSTRIAL LOCOMOTIVES FOR ROAD WORK
The remarkable service rendered by Cummings gasoline locomotives on different concrete road jobs is described in detail in the literature of the Cummings Machine Co., Minster, Ohio.

SPEEDY ROCK DRILLS
The Denver Rock Drill Manufacturing Co., Denver, Colo., will send a copy of its booklet describing the speedy service of Waugh Clipper drills in rock-drilling operations to any interested contractors.

ASPHALT ROAD MACHINERY
The Iroquois Sales Dept. of the Barber Asphalt Paving Co., Land Title Bldg., Philadelphia, Pa., in its complete catalog and bulletin describes in detail the Iroquois tandem roller and other equipment of the Iroquois line, especially built for asphalt road work.

ROAD-OILING DATA
Contractors and engineers wishing information and prices on road oils may secure data from the Standard Oil Co. of Indiana, 910 South Michigan Ave., Chicago, Ill.

CONTRACTORS' TRENCH PUMPS
Full data regarding the No. 3 contractors' pump which has proven a most desirable trench pump, suited to almost any purpose of the contractor, is given in detail in a booklet which may be secured from A. A. Parker, Waterford, N. Y.

GASOLINE SHOVELS
The Excavating Machinery Division of Pawling & Harnischfeger Co., Milwaukee, Wis., has just issued a new bulletin, 56 X, containing over 70 illustrations showing P. & H. excavating machinery on the job in all parts of the country, and de oted particularly to a new type of gas shovel with corduroy traction.

HIGH-GRADE CONCRETE MIXERS
The mechanical reasons why many contractors prefer the Ransome 21 E paver are told in Bulletin 106, which may be secured from the Ransome Concrete Machinery Co., 1772 Second St., Dunellen, N. J.

CRANES AND DERRICKS
Terry cranes and derricks, which are used extensively by building and general contractors, are described in detail in the literature of the Terry Manufacturing Co., Grand Central Terminal, New York City.

EXPANSION JOINTS FOR VARIED USES
Samples and prices of various types of expansion joints for different services may be secured by writing to the Servicised Products Co., First National Bank Bldg., Chicago, Ill.

PERMANENT CULVERTS
Full descriptive illustrated literature giving facts regarding Newport genuine open-hearth corrugated iron culverts may be secured free by writing to the Newport Culvert Co., 542 West 10th St., Newport, Ky.

WHEELED SCRAPERS
Special Bulletin F 118, issued by Smith & Sons Mfg. Co., 1512 Guinotte, Kansas City, Mo., gives detailed information regarding Roytrac unit wheelers, which save time and money and increase the daily yardage of dirt moved.

ACETYLENE FLARE LAMPS FOR NIGHT WORK
The Alexander Milburn Co., 1420-1428 West Baltimore St., Baltimore, Md., will furnish information and illustrated literature to contractors interested in the use of acetylene flare lamps for expediting night work on rush jobs.

HIGH-GRADE ROAD MACHINERY
"Everything for the Road Builder" is the title of the catalog of the Good Roads Machinery Co., Inc., Kennett Square, Pa., which contains full information regarding this company's line of rock crushers, road rollers, road graders, heating kettles, oiling machinery, culvert pipe, road-drags, and snowplows.

EARTH-HANDLING MACHINE
The Bay City Dredge Works, 2622 Center Ave., Bay City, Mich., describes in its illustrated catalog its specially built one-man excavator for clay, sand or gravel pits for road contractors.

TRACTOR CRANES FOR CONTRACTORS
The new types BC and BT crawling tractor cranes, manufactured by the Industrial Works, Bay City, Mich., are described in detail in bulletins which may be secured free on request.

A HIGH-CAPACITY LIFTING-JACK
Bulletin 29, issued by the McKiernan-Terry Drill Co., 19 Park Row, New York City, describes in detail its Doughboy Jack in sizes from 15 to 100 tons, which is claimed to be the lightest jack made for its capacity.

CLAM-SHELL BUCKETS
The illustrated literature of the Owen Bucket Co., 418 Kirby Bldg., Cleveland, O., describes in detail the essential features of the Type "O" Owen bucket for handling crushed stone and other building materials from cars.

EXPANSION JOINTS FOR PAVEMENTS
The Ideal expansion joint, manufactured by the Waring-Underwood Company, Fernwood, Pa., for use with wood block, brick, stone and concrete pavements, is adequately described in literature which may be secured free on request.

SURFACE HEATERS FOR ASPHALT REPAIRS
Illustrated literature describing the use of the Lutz surface heater for softening asphalt and bituminous pavements for repairing may be secured from the Equitable Asphalt Maintenance Co., 1901 Campbell St., Kansas City, Mo.

A ROAD-BUILDERS' CATALOG
General Catalog No. 21 F, published by the Austin-Western Road Machinery Co., Chicago, Ill., contains full details regarding scarifiers, attachments for graders, combination graders and scarifiers, block scarifiers and combination roller scarifiers.

DRAGLINE EXCAVATORS
Bulletin G-G, which may be secured from the Bucyrus Co., South Milwaukee, Wis., describes in detail Bucyrus dragline excavators, railroad type and revolving shovels, dragline excavators, dredges, etc.

HEAVY-DUTY MOTOR TRUCKS
An economical heavy-duty motor truck which eliminates waste in gas and oil consumption and has minimum repairs, is described in detail in the literature of the Autocar Co., Ardmore, Pa.

SELF-LOADING SCRAPERS
Baker scrapers that dig, load, haul and spread are described in detail in the illustrated literature of the Baker Manufacturing Co., 503 Stanford Ave., Springfield, Ill.

STEAM AND MOTOR ROAD ROLLERS
All types and sizes of road rollers with and without scarifier attachments are described in detail in catalog A, which may be secured free on request from the Buffalo-Springfield Roller Co., Springfield, Ohio.

CRUSHED STONE AND GRAVEL CONVEYORS
Instructive catalogs describing Weller conveying and power-transmitting machinery, including belt and drag conveyors, bucket elevators, stone crushers, cranes, power shovels, etc., may be secured from the Weller Mfg. Co., 1820-1856 N. Kostner Ave., Chicago, Ill.

FULL CIRCLE REVOLVING CRANES
Full circle auto and revolving cranes are described in detail in bulletins which the Byers Machine Co., 480 Sycamore St., Ravenna, O., will send to any interested contractors.

WELDED TANKS AND STEEL STACKS
The literature of the Heil Co., 1243 26th Ave., Milwaukee, Wis., contains details regarding the complete line of welded tanks for a working pressure of 100 pounds, storage and underground tanks, oil receivers, dump bodies and hydro-hoists for motor trucks, as well as steel stacks for power-plants.

COMPLETE CONTRACTORS' CATALOG
The Standard Scale and Supply Co., 1631 Liberty Ave., Pittsburgh, Pa., will send on request a copy of its catalog No. 69, describing the "Standard" line of contractors' equipment, including concrete mixers, hoists, pumps, engines, elevators, wheelbarrows, etc.

CULVERT AND SEWER PIPE
Full information regarding culvert pipe, sewer pipe, hollow building tile and drain tile may be secured by writing to the Delaware Clay Products Co., 807 Westinghouse Bldg., Pittsburgh, Pa.

TRACTORS FOR ROAD BUILDING
The advantages of the Cletrac tank-type tractor are described in detail in literature which may be secured from the Cleveland Tractor Co., 19211 Euclid Ave., Cleveland, O.

REINFORCEMENT FOR CONCRETE ROADS
A new specification covering fabric reinforcement for concrete road construction, which is clear and definite, may be secured free from the National Steel Fabric Co., 709 Union Arcade, Pittsburgh, Pa.

MOTOR TRUCKS FOR GENERAL HAULING
The Selden Truck Corp., Rochester, N. Y., will send to any contractor its literature describing the various types of Selden trucks and their uses in the contracting and hauling field.

MOTOR TRUCKS FOR ROAD BUILDING
The GMC Road Builder motor truck, a specially equipped motor truck with a 1-yard capacity body for concrete or other materials, is described in special circulars which may be secured from the General Motors Truck Co., Pontiac, Mich.

ASPHALT TO SPECIFICATION
The Pioneer Asphalt Co., Lawrenceville, Ind., makes a specialty of furnishing Pioneer asphalt complying with practically every asphalt or bituminous specification. Quotations and information will be sent on request.

AN AUTO HEATER AND DISTRIBUTOR
The Kinney Mfg. Co., 3529 Washington St., Boston, Mass., will send full information regarding its patent combination auto heater and distributor for heating and applying all kinds of bituminous materials to roads.

LOW CONCRETE MIXING COSTS
The Koehring construction catalog No. C-6, issued by the Koehring Co., Milwaukee, Wis., contains interesting information regarding Koehring mixers in various capacities and the reason for the low cost of concrete mixing with these machines.

INDUSTRIAL RAILWAY EQUIPMENT
Road catalog No. 100, issued by the Koppel Industrial Car & Equipment Co., Koppel, Pa., describes its industrial railway cars, batch boxes and trucks, which save time, speed up the work and mean increased profits to the contractor.

ASPHALT AND TAR HEATERS
Littleford Bros., 500 East Pearl St., Cincinnati, O., manufacture the Andresen asphalt road repair outfits, tool heaters, pouring pots, asphalt paving tools, tar and asphalt heaters, all of which are described in illustrated literature which may be secured free on request.

A NEW RAPID COMPUTER
A new simplified computer for engineers, inspectors, designers, etc., built like a transit and instantly convertible for desk use or for carrying in the pocket, is described in folder 80 U, issued by the Computer Manufacturing Co., 340 Sansome St., San Francisco, Calif.

CASTINGS FOR MANHOLES, ETC.
The H. W. Clark Co., Mattoon, Ill., has just issued a new folder giving detailed illustrations of its complete line of catch-basin castings, sewer and manhole covers and grating, etc.

PROFIT IN TRAILER HAULING
In its Bulletin Series 1026 CE the Trailmobile Co., 587 E. Fifth St., Cincinnati, O., gives details as to how the Trailmobile has been profitable in various fields of hauling.

HOW TO PAVE WITH SHEET ASPHALT
The Asphalt Sales Dept. of the Texas Co., 17 Battery Pl., New York City, has just issued a new booklet on sheet asphalt paving which will be of interest and value to highway builders.

A HANDBOOK OF STEEL WINDOW SASH
A copy of the handbook of Truscon steel sash, which contains 80 pages of standard dimension tables, architectural details, specifications and illustrations and is particularly interesting to engineers, architects and contractors, may be secured free by writing to the Truscon Steel Co., 250 W. Lafayette Blvd., Detroit, Mich.

NEW PNEUMATIC TOOL CATALOG
The Dayton Pneumatic Tool Co., Dayton, O., has just issued a new catalog, No. 21-D, describing its complete line of pneumatic riveting and chipping hammers and sand rammers, which will be of value to contractors using this type of tool.

PORTLAND CEMENT FOR EASTERN CONTRACTORS
Eastern contractors who are in the market for Portland cement will find it worth their while to send for the literature and prices of the Pennsylvania Cement Co., 131 East 46th St., New York City.

SCARIFIERS FOR RIPPING UP ROADS
The Porcupine scarifier manufactured by the Universal Road Machinery Co., Kingston, N. Y., is described in detail in a well-illustrated 8-page booklet, which it will send to contractors on request.

HIGH-QUALITY WIRE ROPE
The Williamsport Wire Rope Co., People's Gas Bldg., Chicago, Ill., will send its literature to any interested contractors wishing to know full details and advantages of Williamsport wire rope, which is used in all kinds of contracting work.

CONTRACTORS', ENGINEERS' AND MANUFACTURERS' NOTES

Meeting of Equipment Men

At the annual meeting of the Associated Construction Equipment Distributors, it was recommended that manufacturers adopt a standard size of catalog, as suggested by the Purchasing Agents of America, thus enabling the distributors to bind the catalogs in one, to the advantage of the distributor, the manufacturer and the consumer.

A Trade Practice Committee at the command of both manufacturer and distributor for ascertaining facts wherever differences arise, was established, consisting of Mr. Blaisdell of the Queen City Supply Company, J. A. McDivit of the Henry H. Meyer Company, Baltimore, Md., and W. H. Ziegler, of the W. H. Ziegler Co., Inc., of Minneapolis, chairman.

The association will serve for the first time in the construction field to raise the standard of ethics, and try to be of service not only to the manufacturer, but to the distributors and consumers as well. Any contractor purchasing equipment need only get in touch with the association to obtain facts on any make of machinery. To become a member of the association, one must be a distributor in the true sense, having warehouse, stock, office force, etc.

George F. Smith of St. Louis is president of this association; W. H. Ziegler of Minneapolis, vice-president; W. R. Hunter, Room 201, 124 Second Street, Milwaukee, Wis., secretary; and W. B. Louer, Chicago, treasurer.

Bucyrus Moves New York Office

The Bucyrus Company, South Milwaukee, Wis., has announced the removal of its New York City office to Suite 728, 30 Church Street, with E. G. Lewis in charge as Eastern Sales Manager, to be effective December 1. Mr. Lewis has for many years been connected with the sales organization of the Bucyrus Company, both in Chicago and in New York, and has also had wide experience in railroad and general contracting work in this country and abroad.

M. J. Woodhull, who has had large experience in the manufacture and sale of railroad construction equipment, has been appointed Central Sales Manager to succeed Mr. Lewis, in charge of the Chicago office, 622 McCormick Building. E. R. Weber is appointed Northern Sales Manager at 1224 McKnight Building, Minneapolis, Minn., to succeed J. N. Gawthrop, who will become associated with Mr. Lewis in New York. Mr. Weber is well known to contractors in the Northwest, where he has been connected with the engineering, manufacturing and sales department of the Bucyrus Company for the last fifteen years.

Important Siphon Contract Let

The Board of Water Supply of New York City has awarded to Frederick Snare Corporation, 8 West 40th Street, New York City, the contract for the construction of fourteen siphon pipes aggregating about 34,000 feet in length, in that part of the Catskill Aqueduct between the Hudson River and the Kensico Reservoir, at an estimated price of $2,978,000. There are seven pipe siphons in this portion of the aqueduct, in each one of which two siphon pipes are now to be constructed in addition to the existing single pipe line. These siphons will consist of riveted steel pipes from 7 feet 4 inches to 8 feet 6 inches inside diameter, lined with Portland cement mortar, enveloped with concrete and covered with an embankment of earth or of earth and rock.

These pipe siphons when completed, with two other sections recently contracted for, will insure delivery of water from the Schoharie Reservoir in addition to the supply now derived from the Esopus watershed, and will increase the yield of water to New York City to about 1,100 million gallons per day.

Seven of the pipe siphons aggregating 19,400 feet in length of single pipe line, now carrying water from Ashokan Reservoir, were constructed by Frederick Snare Corporation, then styled The Snare & Triest Co., in 1910-1912.

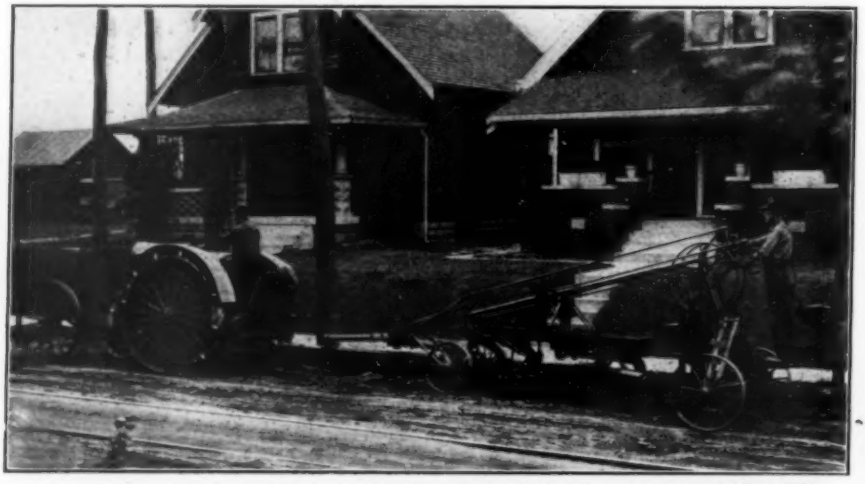
Convention of American Concrete Institute

The program for the convention of the American Concrete Institute at Cleveland, Ohio, February 13, 14, 15 and 16, 1922, allows for nine convention sessions, two sessions a day for three days, and three sessions on the fourth day. This program will be divided into two sessions for contractor problems, that is, the practical problems on the job; two sessions for concrete products manufacturers; one session on roads; one session on houses; one session on research; and two sessions on engineering design and inspection. The Institute committees this year are probably better organized to thoroughly cover the work of the concrete field than they have ever been before.

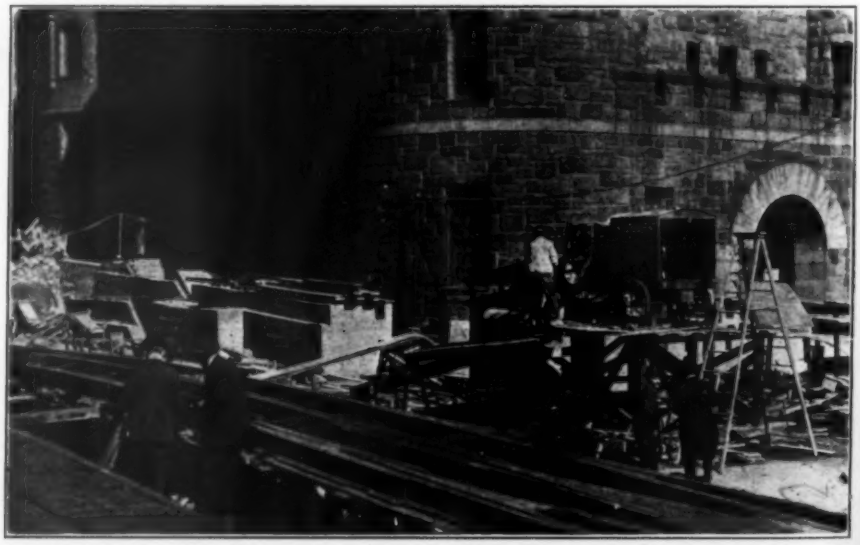
S. M. Williams Now with Autocar

S. M. Williams, Chairman of the Federal Highway Council, which has discontinued its highway activities, has become a special representative of the Autocar Company, Ardmore, Pa. Mr. Williams began his highway work with the organization of the Highway Industries Board during the war. Following the disbanding of the Board, he formed the Federal Highway Council, which in the last few years has been active in developing store-door delivery, studying subsoils of highways, and supporting useful highway legislation.

Equipment for Highway, Street and Grading Jobs



A SUPER-FOUR HUBER TRACTOR PULLING A STREET GRADER IN INDIANAPOLIS, IND.



A REPUBLIC MIXER SOLD BY THE HOISTING ENGINE SALES COMPANY, INC., NEW YORK CITY, THAT DID GOOD SERVICE ON THE 42ND STREET SUBWAY EXTENSION, NEW YORK

A 10-TON HOLT CATERPILLAR TRACTOR HAULING A 10-FOOT AUSTIN RIP-SNORTER GRADER

This outfit is used in flood prevention work along the Scioto River, Ohio, in grading off the levee bank prior to putting in a concrete wall. The grader rides down on the slope and the tractor on top of the levee. A 40-foot cable is used as a connection between the tractor and the grader. The tractor was sold to the contractors, W. E. Callahan Construction Company, Columbus, Ohio, by the Sykes Company of that city

Taking Stock of the Business Situation

Speaking in a leisurely way, and after the manner of a "parlor road builder," as those of us who are not actually engaged in construction are sometimes called—and appropriately so—the winter lull in road-building offers an opportune time for taking stock of the situation. The recovery in trade, the improvement in the banking situation, and subjects of kindred type, have been somewhat overshadowed in recent days while the world endeavors to visualize developments which may come to pass as a result of the deliberations in Washington on the limitation of armament. There is almost universal enthusiasm at the moment in the reception which has been accorded the proposals of the United States, since it appears that extravagance in expenditures for war materials may be sharply curtailed. There is something tangible upon which to focus one's vision in the tremendous saving which would be effected by the establishment of a ten-year naval holiday.—*Highway News Digest.*

A KOEHRING 14E PAVER EQUIPPED WITH GOODYEAR SOLID RUBBER TIRES, IN BROOKLYN, N. Y., DOING PATCH WORK FOR THE CONSOLIDATED ASPHALT PAVING COMPANY

Legal Decisions in the Contracting Field

Edited by A. L. H. Street, Attorney-at-Law

A Contract Clause Permitting Suspension of Work, Construed

A sewer construction contract with the city of New York contained a clause permitting the president of the borough to suspend the work, if he should deem it to the interest of the city to do so, without compensation to the contractor on account of the suspension, other than extending the time for completing the work. Holding that this clause did not deprive the contractor of the right to recover damages caused by the city's suspension of the work for lack of funds to pay for engineering and inspection services it was bound to furnish under the contract, the Appellate Division of the New York Supreme Court said in the case of Johnson v. City of New York, 181 New York Supplement, 137:

"Was it the intent of the parties that this power to suspend work, entailing as it did great expense on the contractors, could be exercised because the city had failed in the performance of its obligation? I think not. It cannot be assumed that a clause in the contract was intended to authorize one of the parties to impose the result of its own default upon the other. A court should not so interpret a contract, unless required so to do by the most explicit terms. There is room enough for the proper operation of the clause, without giving it interpretation so unreasonable."

Right to Have Improvement Warrants Canceled

In the case of Coosa County v. J. H. Scruggs Construction Company, 89 Southern Reporter, 527, the Alabama Supreme Court holds that where a county, after issuing warrants in payment for a bridge, discovers that the bridge has been faultily constructed, in violation of the terms of the contract, the county may sue to require surrender or cancellation of enough of the warrants to cover the damage resulting from the breach of contract. It was unsuccessfully urged by defendants in this case that the county's exclusive remedy was a suit for damages against the contractor or on his bond. The Court also recognizes the right, under such circumstances, to have part of the warrants cancelled, although they may have been assigned to a third person.

Municipal Contractor's Bond May Validly Require Him to Discharge Claims of Subcontractors and Material Men

The fact that a contract for a municipal improvement (in this case, public buildings) does not bind the contractor by agreement with the city to pay off all labor and material claims arising in favor of third persons, does not vitiate provision to that effect in the contractor's bond, securing performance of the contract, holds the New Hampshire Supreme Court in the case of William H. Toner & Co. v. Long, 111 Atlantic Reporter, 311.

This decision is reached despite the fact that the city may not be held responsible to the labor and material claimants and has no other direct interest in whether their claims are paid or not. Upholding the right of subcontractors to recover on such a bond, although not parties to it, the Court says:

"The further contention that the city had no power to enter into a contract which was intended to operate for the benefit of third parties, who sustained no relation of privity to it at law, and in whose undertaking the city was not legally interested, and whom it was not legally liable to pay for their services, disregards what may be termed the incidental power of the city when exercising its undoubted right (as, for instance, its right to contract for the erection of municipal buildings), and its interest in having its proper work done in a proper way. It is not true that it had no substantial interest in having the work which was done by the plaintiffs well done, or that it was a matter of indifference to it whether the plaintiffs were amply secured by a bond in their favor. To secure the best results, the obligation of the surety to the subcontractors might seem to the city to be desirable, as an incident of its contract for the construction of the buildings. The payment of the premium to the surety was equivalent to the establishment of a trust fund in the hands of the surety for the benefit of the plaintiffs, if the contractor failed to pay them for their services."

Principles of Correct Pipe Threading

An Interesting Discussion for Those Who Use Power Pipe-Threading Machines

IN using a power pipe-threading machine it is essential that the pipe and dies be properly aligned, for if the pipe, especially in the larger sizes, does not revolve true, it is reasonable to suppose that it is going to cause a greater wear and strain on certain dies than on others. All the small pipe-threading machines made by the Williams Tool Corporation, Erie, Pa., have self-centering chucks, and it is no trouble to grip the pipe accurately on these machines. But even with the Williams machine, the rear scroll chuck should first be tightened firmly, for the reason that if you tighten the front gripping chuck first, it is often impossible to bring the hand scroll jaws all down even on the pipe, as you are pulling against the front gripping chuck, which has been closed tight with a wrench.

When the pipe has been put in the machine, the front gripping chuck should be closed until the jaws all bear loosely on the pipe. Then the scroll chuck on the rear is made as tight as it can be pulled, after which the front gripping chuch is tightened sufficiently to drive the pipe. When independent chucks are used on the front of the larger machines, this tightening is very important and should be carefully watched, otherwise the pipe will be out of true nine times in ten. All independent chucks are plainly marked to show just where to set each jaw for a given size of pipe. Care should be taken by the man operating the machine to see that all the jaws, when adjusted in or out, are set equal as to markings.

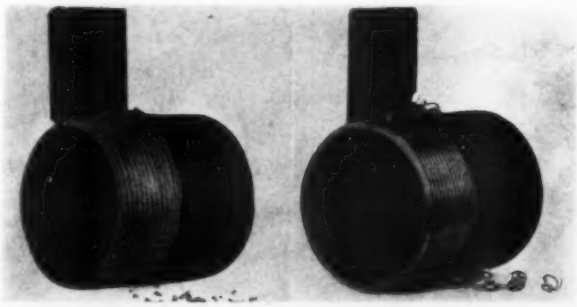
The Proper Lip

To clearly illustrate what is meant by "lip on a chaser" two illustrations are shown below. The one at the left shows the chaser that has practically no lip, and the one at the right shows a chaser having a proper lip on the cutting face. The lip has several duties to perform. It allows the chip to curl off clean and leave a smooth thread. It also gives an easy cutting action to the die, similar to that of a properly ground lathe tool, instead of the pushing effect which results with a die having no lip. It also permits increased cutting speed, which is very desirable.

The angle to which the lip should be ground on a chaser depends considerably on the kind of material to be threaded, and the style and condition of the chaser and chaser holder. For ordinary steel pipe this angle should be from 10 to 15 degrees, but a chaser intended to cut open hearth steel pipe should have a long, easy lip, because of the soft character of the material of which the pipe is made. For open hearth steel the lip angle should be at least 15 degrees.

In all cases the back or top of the lip should be rounded to eliminate square corners or shoulders, in which chips catch and pack up. The different angles of lip for cutting different materials are shown on page 68 in the two left-hand illustrations, and that on the right shows how a die with practically no lip pushes the metal from the pipe in the form of crumbling chips. Chasers should always have a full lip across the entire width of the cutting face, as shown on page 69, and the depth of lip should be the same at A as at B. There are many undesirable consequences of using dies without the proper lip. The extra power required to force them through the pipe creates unnecessary friction and has a tendency to break out the teeth of the die, which will then pick up "stickers," tearing the tops from the thread.

The lips on new dies as furnished from the factory are supposed to be correct, and the same angle and height should always be maintained when they are being reground. If the facilities of the contractor are such that he cannot afford to do this successfully, he should take care not to ruin the dies by inferior grinding. They should be sent back to the factory, where they can be reground properly, after which they should be practically as good as new.



A PROPERLY DESIGNED DIE IS NECESSARY. AT LEFT—ROUGH THREAD CUT WITH CHASER HAVING NO LIP. NOTE CRUMBLING CHIPS. AT RIGHT—A CLEAN, STRONG THREAD CUT WITH PROPERLY DESIGNED DIE. NOTE SPIRAL CHIPS

The Proper Chip Space

Chip space is the space required immediately in front of the die to prevent the accumulation or packing up of chips of cuttings. The importance of this feature cannot be too strongly emphasized, for if sufficient chip space is not allowed, the chips will rapidly pack in front of the die, causing rough, torn threads and creating a tendency on the part of the die to pick up stickers. On the Williams pipe machine ample provision has been made for chips and cuttings. All dies when set in the head to cut the proper size of pipe, project about ¼-inch beyond the inside diameter of the head, leaving sufficient space for cutting.

When cutting a large number of threads of any one size, the cuttings must of necessity be brushed out of the head from time to time, and when changing the dies in the head, the dirt, grit and cuttings should be thoroughly cleaned out before the dies are removed, thus preventing unnecessary cuttings from getting into the die slots and cam.

The Proper Clearance

Clearance is the space between the thread of the chasers and the threads of the pipe. This clearance is secured by the manufacturer in various ways and may be determined by certain effects produced by normal operation of the dies in the machine. Anyone that is familiar with threading-machines can very easily determine from looking at a die that has been in use for some time whether it has the proper clearance. The effects of ideal clearance in the threads of a die may be described as follows: When the die is first set in the machine, the sides of the thread are uniformly dark in color, just as they were left after being hardened and tempered. When the die has been in use for some time, the sides of the threads become polished, brighter at the cutting edge, and gradually shading almost to their original color at the back. The chaser which shows this condition will work freely, cut clean, will not tear the thread or clog, and will be durable. When the chasers show a polish from the cutting edge to the back, there is a lack of clearance, causing the cutting edge to work hard, heat, and make rough, torn threads.

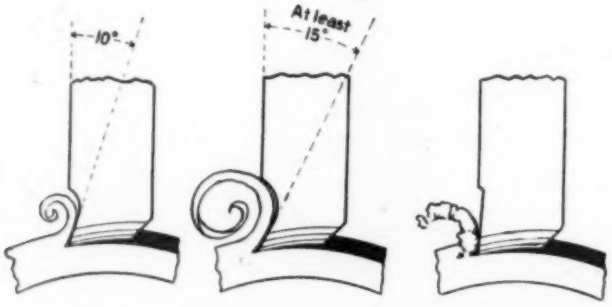
All the dies on a machine should show the same amount of polish near the cutting edge. If one has a higher polish or runs further back on the die, they are not working equal. Of course it is easy to go to extremes in these matters. If too much clearance is allowed, the result will be a wavy thread. Dies with too much clearance and no heel usually cause chattering and its attendant troubles. Dies with these faults are more susceptible to breakage than dies which have been made with due consideration for the points mentioned.

The Proper Lead or Throat

Lead is the angle which is ground on the first three threads (more or less) of each chaser to enable the die to start on the pipe and also to distribute the work of making the first cut over a number of threads. The proper amount of lead is about three threads. As the heaviest cutting is done by the lead, it should have a slightly greater clearance angle than the rest of the threads on the die, but care must be used to see that this angle is not excessive. Too much clearance here will cause the die to lead too fast, and the half-threads cut by the lead are consequently damaged by the full teeth of the die. Great care should also be exercised when regrinding the lead on a die to see that it is kept as near the same angles in every way as the original. It must also be remembered that the full set of dies of any size should all be ground exactly alike. A perfectly good set of dies can be ruined by improperly regrinding the lead.

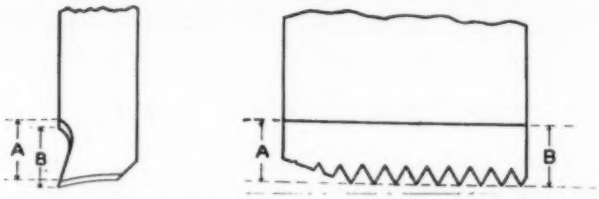
Sufficient Number of Chasers

To get good results in threading at one cut, experience shows that a die should have a suitable number of chasers, the approximate number being determined by the size of the pipe. The more chasers that can be put on a head, the less work there is to do for each die,



PROPER AND IMPROPER CHASERS FOR PIPE CUTTING

Left—Chaser properly lipped for cutting Bessemer steel pipe. Middle—Slightly increased angle of lip for cutting open hearth steel pipe. Right—Insufficient lip angle. This type of chaser will push the metal off instead of cutting it



CHASERS SHOULD HAVE FULL LIP ACROSS ENTIRE CUTTING FACE, AS SHOWN. DEPTH SHOULD BE THE SAME AT "A" AS AT "B"

with the result that the dies have less tendency to clog, snip or break, giving longer life, and there is less likelihood of stripped, wavy or chattering threads. The more chasers in a head, the more bearing points there are to steady the pipe. Consequently, each chaser has less to do, and the thread when cut has less tendency to be wavy or rough.

Proper Cutting Oil

Probably 75 per cent of all die trouble is due to poor and insufficient cutting oil. Care should be taken in the quality of the oil used, as the best die made will not produce good results with poor or insufficient oil. Cheap lubricant is destructive to dies, and more power is required to perform work when it is used. A good cutting oil must possess: (1) ability to act as a cutting fluid, giving the dies a tendency to cut in and make clean, sharp threads; (2) to act as a lubricant and form a film of oil between the die and the pipe, thus preventing metal-to-metal friction; (3) to act as a cooling liquid, absorb the heat and keep the pipe and dies cool.

Very few users of a pipe-threading machine realize just how important a proper cutting oil and plenty of it is to the life of a set of dies. There is hardly another machine in use that has such a large cutting edge bearing on the article being machined as has a pipe-threading machine. On no other machine does the cutting oil play such an important part for or against the success of the machine's product.

On ordinary lathe work it is used very little, while on automatic and special screw cutting and turning machines it is used more extensively, but on none of these machines is there the large cutting surface or as many tools at work as on a pipe machine.

The dies should be flooded with the cutting oil at all times, thus preventing them from heating up, as well as acting as a cutting lubricant. There are many important reasons why there should be a large supply of cutting oil on the dies. On a pipe machine there are anywhere from four to twelve chasers at regular intervals around a complete circle, and it is only reasonable to suppose that with only one or two streams of liquid falling on the pipe and dies from the top there will be some places at the side or bottom that do not get as much oil as those that are at the top near where the oil is delivered. Therefore, if there is not a large volume of oil, it multiplies in scarcity with regard to certain chasers. This causes greater trouble when other than a good grade of cutting oil is used. For if a compound is being used, certain chasers are getting very little and are practically cutting dry or in water, in which case they are bound to heat up, clog and chip. Another feature that must be remembered is that the pipe is revolving one way only and is very often quite large in diameter. This has a tendency to carry the cutting oil away from the chasers on one side, and the only way this can be successfully overcome is to have such a volume of oil falling on the pipe that it is forced down on all sides to flush over the entire chaser in each position.

200,000 Workers to Be Employed in State Highway Construction Under Federal Highway Act

CONSTRUCTION of highways to the total value of $76,400,000, covering 6,261 miles and employing more than 150,000 workers, is about to be undertaken by 30 states, as the direct result of the recent passage of the Federal Highway Act.

According to the act, which created a fund of $75,000,000 to be apportioned among states taking advantage of the 90 days' period, each state will be entitled to receive, on the basis of the value of its work, its specified Federal allotment. These amounts are of course in addition to the allotments received by states under the provisions of former Federal Aid acts. Estimates show that $40,000 will be the average amount per mile expended by the states. When the work is completed and approved by the Federal inspector, the state will receive back from the Government about $20,000 per mile.

Directly and indirectly, probably 200,000 workers will be employed in state highway construction. This means that in addition to those directly engaged in road building there will be a large number indirectly set to work providing material for the builders. These will be employed in quarries, cement mills, sand-banks, asphalt plants, gravel-pits, and shops manufacturing road-building materials and tools.

The Conference on the Standardization and the Elimination of Excess Variety of Vitrified Paving Brick

FIFTY-FIVE sizes and varieties of vitrified paving brick were eliminated by mutual consent at a meeting called in Washington in November by Secretary Hoover of the Department of Commerce. This conference of users and makers of paving brick was held at the suggestion of the National Paving Brick Manufacturers Association, which met with representatives of the Department of Commerce and with representatives of the U. S. Chamber of Commerce in a preliminary conference to determine the areas of standardization possible in this particular industry. As a result of this preliminary meeting, the manufacturers, under the general direction of the Department of Commerce, instituted a variety survey of the vitrified paving brick industry, which formed the basis for the meeting. A permanent committee to be known as the Committee on Simplification of Variety and Standards for Vitrified Paving Brick of the Department of Commerce, was created for the purpose of making other eliminations as time goes on that will be mutually acceptable to producer and consumer.

In addressing the Conference, Secretary Hoover said:

"The proposal that you are considering is no new idea in American industry, but it comes up in its best form on this occasion because it is inspired by the manufacturers themselves.

"One of the problems of the paving brick industry is the wide diversity of style in the demands made upon the manufacturers by engineers, that have increased their cost of production unnecessarily. This problem was brought to the Department of Commerce by the manufacturers themselves. We were asked if we could act as a center point to bring about some agreement in matters in general by which these varieties could be simplified and the cost of production materially decreased. Obviously, the consumer is the engineer, as he makes the specifications and directs the purchase. The manufacturers are helpless to come to any conclusion of this kind unless they can have the coöperation of the engineers who make the specifications and finally pass upon these matters.

"We have had some discussion with the manufacturers on this problem and they themselves have made through their engineers a very careful study of this whole problem. The primary object of this meeting is to see how far an agreement can be reached for the simplification of varieties and how far the consumer will coöperate with the manufacturer in securing these varieties. There is little I can add, though I realize the importance of it. This is but one item which I hope will be extended in a general campaign among manufacturers in all directions. We have more problems of this kind and meetings going on with the help of the Chamber of Commerce in many industries. I believe it is the only practical way in which we can develop these essential groups in industry—that is, by the manufacturers' voluntary action, and if you gentlemen can come to some definite conclusion we shall be glad to give it such prestige as the Department can give. Obviously, if the engineers who direct the work in our cities, and the manufacturers will cooperate in reaching such a conclusion under the agency of the Department of Commerce, there can be no criticism of anybody engaged in this work, and if we can secure that coöperation we shall secure at the same time progress in the industry itself. I look upon this meeting with more than usual interest because it is the first of those processes that we have brought to this state."

After a thorough discussion of the report of the National Paving Brick Manufacturers Association, which contained an exhibit of the tabulation of actual shipments of paving brick of 66 varieties from 1914 to August 1, 1921, motions were made, seconded and unanimously passed by the Conference, reducing the varieties for consideration from 66 to 20. For the basis of discussion, a maximum size of brick, 4 inches in depth by 3½ inches wide and 8½ inches long, and a minimum of 3 inches deep, 3 inches wide and 8½ inches long are used. The following table gives the dimensions and types of the 20 varieties of brick decided upon:

Depth	Width	Length
Plain Wire-cut Brick (Vert. Fib. Lugless)		
Inches	Inches	Inches
3	4	8½
3½	4	8½
Repressed Lug Brick		
Inches	Inches	Inches
4	3	8½
3	3½	8½
3½	3½	8½
4	3½	8½
Vertical Fibre Lug Brick		
Inches	Inches	Inches
3	4	8½
3½	4	8½

Wire-cut Lug Brick (Dunn)		
Inches	Inches	Inches
3	3¼	8½
3½	3½	8½
4	3½	8½

SPECIAL BRICK

Hillside Brick (Dunn)		
Inches	Inches	Inches
3½	3½	8½
4	3½	8½

Hillside Brick (repressed)		
Inches	Inches	Inches
4	3½	8½

Street Railway Brick		
Inches	Inches	Inches
3	3	8½ (Fillers)
3	3½	8½
4	3½	8½
4	3¼	8½ (Stretchers)

Miscellaneous		
Inches	Inches	Inches
4	3¼	8½ (End Cut)
4	3¼	8½

As considerable debate ensued concerning further elimination, a committee was appointed for the purpose of considering the remaining 20 varieties. The committee reported the desirability of reducing the number of sizes so that all brick could be cut out of two clay columns, one 3 inches and the other 4 inches high. It was decided that present demands are such that there must be placed at the disposal of engineers brick to make a wearing surface either 3, 3½ or 4 inches in depth. In the smaller cities a 3-inch pavement is wanted; the larger cities require a 4-inch brick. The state highway departments, on the other hand, find 3-inch brick too shallow for their traffic, and 4-inch brick deeper than necessary, and are therefore specifying a 3½-inch depth. With these three depths considered imperative, the committee found it desirable to eliminate only nine of the varieties over and above those listed above, and therefore eliminated those in the following list:

Depth	Width	Length
Repressed Lug Brick		
Inches	Inches	Inches
4	3	8½
3	3½	8½
Hillside Brick (Dunn)		
Inches	Inches	Inches
3½	3½	8½
Street Railway Brick		
Inches	Inches	Inches
3	3	8½ (Fillers)
3	3½	8½
4	3½	8½
4	3½	8½ (Stretchers)
Miscellaneous		
Inches	Inches	Inches
4	3¼	8½ (End Cut)
4	3¼	8½

Some explanation of these eliminations is called for. A 4x3x8½-inch brick was eliminated, even though a fairly large number of that variety is used, because no hardship is imposed by asking the substitution of a 4x3½x8½-inch brick for it, as this brick is of equal depth but ½-inch wider. No freight is saved on the 4x3x8½-inch over 4x3½x8½-inch.

A 3x3½x8½-inch brick was eliminated simply because it has never been widely used, and even though it is the only repressed size with which a 3-inch pavement can be built, it was believed that it would be a mistake to artificially encourage its use by naming it as a standard.

Coming to the eliminations in the various classifications of special brick, the committee has acted on the principle that as far as possible these varieties should be eliminated. Looking to the wide use of the Hillside type, however, it has deemed this use sufficiently important to retain one size in each of the Hillside classifications, that is, to retain only the 4x3½x8½-inch in Dunn Hillside brick, and the 4x3½x8½-inch in the repressed Hillside brick.

All other specials were placed in the non-standard class and therefore the following are eliminated in addition to those classes eliminated in the first discussion:

Depth	Width	Length
Street Railway Brick		
Inches	Inches	Inches
3	3	8½ (Fillers)
3	3½	8½
4	3½	8½
4	3½	8½ (Stretchers)
Miscellaneous		
Inches	Inches	Inches
4	3¼	8½ (End Cut)
4	3¼	8½

With all the eliminations mentioned above, the number of standard varieties would be 11 and the number of sizes 4, as follows:

Width	Depth	Length
Inches	Inches	Inches
3½	4	8½
3	4	8½
3½	3½	8½
3½	3	8½

The varieties, therefore, that would be retained are as follows:

Width	Depth	Length
Plain wire cut brick (Vertical Fibre Lugless)		
Inches	Inches	Inches
3	4	8½
3½	4	8½
Repressed Lug Brick		
Inches	Inches	Inches
3½	3½	8½
3½	4	8½
Vertical Fibre Lug Brick		
Inches	Inches	Inches
3	4	8½
3½	4	8½
Wire-cut Lug Brick (Dunn)		
Inches	Inches	Inches
3½	3	8½
3½	3½	8½
3½	4	8½
Hillside Lug Brick (Dunn)		
Inches	Inches	Inches
3½	4	8½
Hillside Lug Brick (Repressed)		
Inches	Inches	Inches
3½	4	8½

Night Lighting by Acetylene Flares

Money-Savers Help Contractors Complete Early Winter Contracts

AT this season of the year, when days are short and owners are anxious for completion of work, the night shift becomes a very important factor in the success or failure of a job. By taking advantage of the night shift, progressive contractors are securing work against their competitors, in view of better estimates and better records of completion. They are also getting greater profits out of their work by utilizing expensive plants throughout two or more shifts per day.

In order to get the best results from night work by eliminating delays to men and machines, it is essential that the work be well lighted. One form of light that is now used all over the country and which is giving good service is the portable acetylene flare light. Thousands of these lights were used by the A. E. F. during the World War, for the innumerable purposes where an independent isolated light was required.

There are several types of these lights on the market, but the principle of operation is the same in all. When calcium carbide and water are combined, a combustible gas called acetylene is generated. Calcium carbide, usually called carbide, comes in several forms. The form most generally used is ordinary commercial carbide in lumps 2 inches by a half-inch in size, as this size yields the greatest number of cubic feet of gas per pound, and is obtainable everywhere. One pound of lump carbide gives about 4.84 cubic feet of gas, and the average cost of lump carbide is 5 cents, making the cost of the gas about 1 cent a cubic foot.

NIGHT OPERATION OF A STEAM SHOVEL

The two lights in the foreground give 12,000 candle-power each, burning 12 hours on a charge of 12 pounds of carbide. On the running-board of the shovel is the tank of a 25,000-candle-power light with hose leading up to the burner and reflector mounted on the cab

The charging and lighting are easily performed by unskilled labor. The carbide is placed in a carbide holder containing a series of conical-shaped pockets. This holder fits into a gas bell slightly larger, there being only enough space between the two to form a gas chamber. These in turn are placed in a square tank which forms the base of the light and is filled with water. The water acts on the carbide, immediately generating a gas in the chamber, which rises through an inverted "U" pipe, travels down through a gas washer in the base and thence up through the feed pipe to the burner.

The sludge or slaked carbide is easily removed from the conical pockets by taking out the carbide holder and dumping. The water in the tank need not be changed. The standpipe, burner and reflector are not handled.

A Brilliant and Economical Light

The brilliancy of the light is assured by the relatively large water-supply in the square tank. The water column automatically maintains a steady flow of gas at the burner without any attention whatever. As the internal pressure within the light can never exceed the water column, a large factor of safety is assured. When the light is turned off, the increased pressure of the gas automatically forces the water from the carbide chamber, preventing any generation while the light is out. This not only insures safety, but makes the light ready for use at all times. When fully charged, these lights will burn from 10 to 12 hours with practically no care.

They come in various styles and sizes, ranging from the small hand lamp to the large multiple burner type. An 8,000-candle-power light is 6 feet high, weighs about 150 pounds, and is equipped with handles so that it may be carried from place to place without difficulty. It burns for 12 hours on 8 pounds of carbide. The flares made by the Alexander Milburn Company, 1420 West Baltimore Street, Baltimore, Md., have an excellent device for cleaning the burner as it pushes the obstruction out of the burner. By means of swivel joints the light may be swung in a complete circle either horizontally or vertically. The reflectors are attached with a reflector holder which can be put on or off while the light is burning, and is of the movable form type, making it possible to

MAKING NIGHT WORK PROFITABLE WITH A BATTERY OF PORTABLE CARBIDE LIGHTS

spread the light over a wide area or concentrate it upon the work at hand.

The acetylene flare light has been used for years by many of the largest contractors and has been found very satisfactory.

Some of its applications are in tunnel work, concrete-lining tunnels, for drill runners, in excavation work, for steam rock drills loosening up material for scrapers next day, on revolving shovels, grading, pile driving, unloading material for concrete mixers, in railway yards during late afternoon work, electric line repair work, on buildings for carpenters, and installing machinery.

A Gasoline Shovel in Dangerous Mountain Road Work

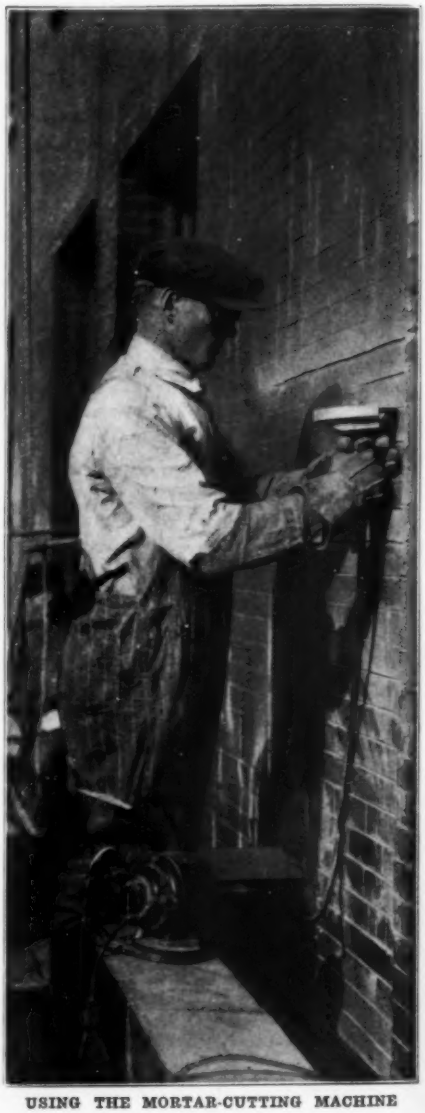
THE accompanying illustration of the Bear Creek Road job in California, shows an interesting application of a Pawling & Harnischfeger gasoline-driven power shovel used by the contractor, C. Miles. This road work, 3,000 feet above sea level in the Santa Cruz Mountains, was done at a figure 30 cents per cubic yard less than estimated by experienced excavating contractors, and illustrates that the freedom of movement of a gasoline-driven shovel is an important factor. The work was done by excavating one side of the road and over-casting to form the other half. Because of requiring no water pipe line to the shovel, it may be operated in remote locations far away from the source of supplies. The gasoline fuel used in comparatively small amount is easier to supply than coal, wood or crude oil. The corduroy traction gives the mobility needed to operate continuously, one man on the shovel having all movements of the bucket and machine under his control. The services of licensed engineer and firemen are not required.

IN ACTION IN A ROUGH COUNTRY

Machine for Cutting Out Mortar Before Pointing

THE R. G. Haskins Company, 27 South Desplaines Street, Chicago, Ill., has developed a machine for cutting out the mortar between bricks and building-stones before point tucking. This machine is known as the Haskins Type B-4 equipment, and consists of a ¼-horse-power motor operating at 3,500 revolutions per minute, directly driving a grinding wheel of the proper thickness to cut the required groove. The grinding wheels are furnished in 3/32- and ¼-inch widths. The motor is such that it can be run either horizontally or vertically. The shaft is direct-connected with the motor and is 5/16-inch in diameter and 5 feet long, suitable for transmitting ¼-horsepower. The shaft is provided with a metal-wound casing hand piece and guard, as shown in the illustration. The wheels used for grinding are made of a special rubber bond composition, 6 inches in diameter.

The Chris Paschen Company is employing a battery of three of these machines on the Chicago Telephone Building at this time, and reports that each machine does the work of five men in preparing the joints for pointing and has been very successful in making a smooth, clean job.



USING THE MORTAR-CUTTING MACHINE

Activities of Consulting Engineers

J. D. Trammel, Fort Worth, Tex., and W. R. Holway, Tulsa, Okla., have been named engineers for the $6,800,000 project to provide a permanent water-supply for Tulsa, Okla. The bond issue was passed by a vote of about 3 to 1 on November 29, 1921.

E. S. Draper, Landscape Architect, 11 East 5th Street, Charlotte, N. C., has been retained by the Fayetteville Insurance and Realty Company, Fayetteville, N. C., to make surveys and plans for a suburban real estate subdivision. He has also been retained by J. E. Beaman, Raleigh, N. C., to plan the development of a tract of real estate in Hayes-Barton. Allen Brothers, Raleigh, N. C., have also secured the services of Mr. Draper to plan and develop park areas at Hayes-Barton.

Benham & Mullergren, Consulting Engineers, Kansas City, Mo., who are the engineers for sheet asphalt paving in Downs, Kans., have announced that the awards for the contract for paving Districts 2 and 3 were made to A. R. Young & Company of Kansas City, Mo. Benham & Mullergren, who will supervise construction, have also announced the award of the sewage disposal contract for the city of McAlester, Okla., to John W. Rooks, of McAlester, Okla., at $31,752.49 on November 4, 1921.

Arthur H. Blanchard, Consulting Highway Engineer and Professor of Highway Engineering and Highway Transport at the University of Michigan, Ann Arbor, Mich., has been appointed representative of the Executive Bureau of the Association Internationale Permanente des Congres de la Route. He will select reporters on seven topics in the fields of highway engineering and highway transport to be taken up at the Fourth International Road Conference to be held in Spain in 1923.

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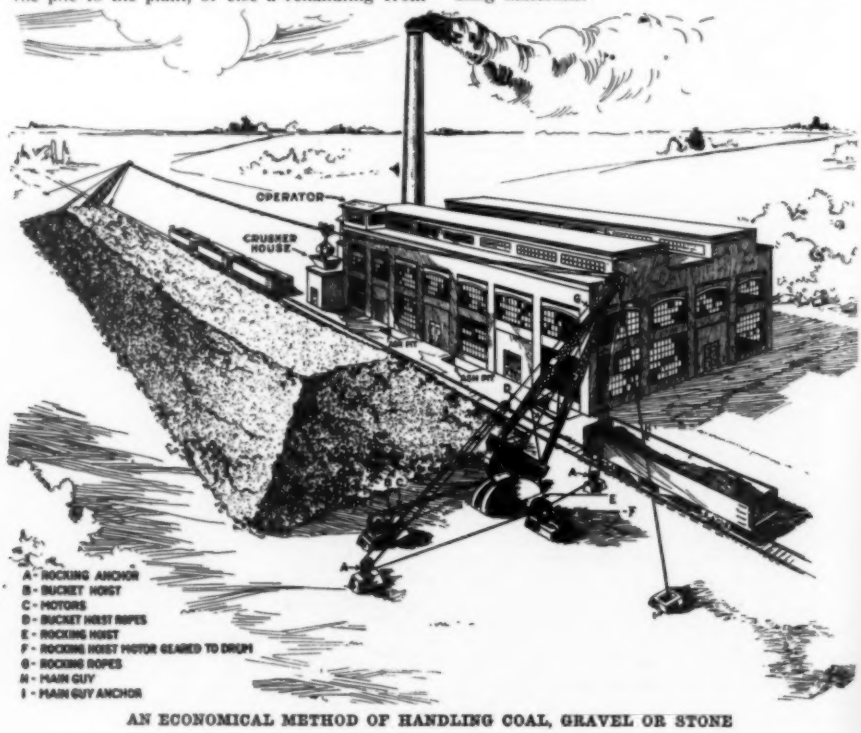
A Rocking Cableway for Material Handling

A ROCKING cableway applicable to the handling of any kind of bulk material that is usually handled by the grab bucket, or materials that can be handled by crane-hook or packet, has been developed by the Railway and Industrial Engineering Company, Greensburg, Pa. The Harrington system of material handling consists of a balanced rocking cableway embodying crane service with cableway speed. It is in reality an improved cableway for giving crane service over storage yards. It is particularly applicable to coal storage, crushed rock storage, storage for cement mills, lumber yards, structural steel storage, foundry yards, and, in fact, to the handling of any materials stored in selective piles or moved to and from cars, pockets, mills or storage yards.

Speed over a given area has always been essential in the handling of materials. The Harrington system is a cableway in which the supporting towers run in unison through 120 degrees by means of cables controlled by the operator. The cableway speed is obtained over a large dumping and reclaiming area. One of the difficulties which have been experienced in earlier apparatus is its slow longitudinal movement. This has meant either a heavy installation cost if the material is moved directly from the pile to the plant, or else a rehandling from the pile to a car, moving the car to the plant and then unloading.

In this system it has been the aim to eliminate the handling of material to conveyor or car by furnishing a high longitudinal speed along the pile, making it possible to travel a considerable distance from the plant, pick up a load and convey it rapidly to the plant, and vice versa. This has been accomplished by adopting the cableway principle, which affords very high longitudinal speed with light moving weight of longitudinal parts, while the lateral service is provided by means of a rocking motion which is given to terminal towers. These towers are rocked in unison, so that the main track cable is transferred laterally.

This device makes it possible to give fast crane service over depressions in the ground, as the main cable can be stretched across openings where it is impossible to get supports or tracks for any other kind of mechanism. It can also operate over buildings or other obstructions, making areas useful for storage which are otherwise unavailable. The cableway can be operated either by steam or electricity, and requires but one operator. It is claimed to greatly reduce both hoisting and conveying time and therefore materially reduces the cost of handling materials.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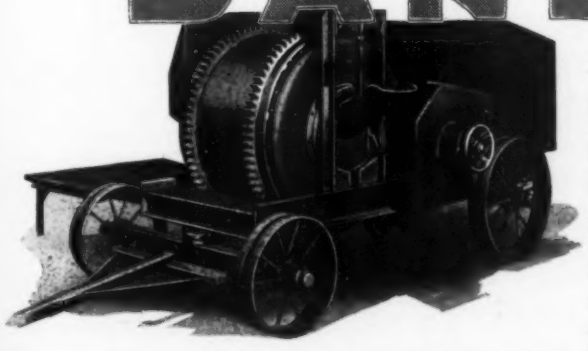

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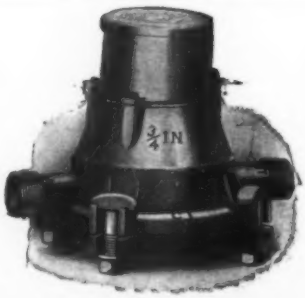

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INDEX TO ADVERTISERS

After referring to the "Where to Purchase" Section, on pages 3 to 37, if you will look up the advertisements as per index below, you will be able to secure further data (with illustrations in many cases) on the material or equipment relative to which you are seeking information.

Acme Road Machy. Co..... 6
Alexander, Edgar..... 79
Allis-Chalmers Mfg. Co..... 91
Alpha Portland Cement Co..... 88
American Chimney Corp. of N.Y. 36
American Park Builders..... 96
American Well Works..... 92
Anderson Tool & Sup. Co., W. H. 81
Archer & Co., E. T..... 96
Ashmead, Henry C..... 78
Austin Machinery Co., W. E.... 79
Austin-Western Road Mach'y Co. 30
Autocar Co..... 40

Badger Meter Mfg. Co..... 94
Baker Mfg. Co..... 18
Banks & Craig..... 96
Barber Asphalt Paving Co..... 100
Barrett, Thos. L..... 80
Barrett Company, The..... 91
Bay City Dredge Works..... 12
Becker & Becker..... 81
Bentley, E. W..... 79
Best Tractor Co., C. L..... 91
Boehck-Lowe Machy. Co..... 86
Brandeis Machy. & Supply Co... 81
Brewster & Williams, Inc..... 84
Brooks Co., R. E..... 83
Brown, Fraser & Co..... 87
Brown, Thos. M..... 81
Brown & Sites Co..... 83
Bucyrus Co..... 30
Buffalo-Springfield Roller Co.... 28
Buhl Machine Co..... 79
Burnap, George..... 96
Byers Machine Co..... 20

Cameron & Barkley Co., Inc.... 79
Carey Co., Philip..... 37
Central Foundry Co..... 10
Chester Engineers, J. N..... 96
Cleveland Tractor Co..... 32
Conard & Buzby..... 97
Conboy Co., John A..... 85
Conklin & Harrington, Inc..... 83
Connery & Co..... 18
Coulter, Waldo, S..... 97
Cox, H. L..... 85
Crane Co..... 92
Craven Co., Frank T..... 87
Curtiss-Willis Co., The..... 87

Davis Engineering Co., C. B.... 78
Davis Equipment Co..... 83
Delaware Clay Products Co..... 36
Denver Rock Drill Mfg. Co..... 22
Dewey Supply Co..... 83
Dopp & Co., J. W..... 82
Draper, E. S..... 96
Du Pont de Nemours & Co., E. I.. 88

Edelen & Co., Inc..... 85
Ehrbar, Inc., Edward..... 83
Electric Railway Equipment Co. 89
Elmes, Frank W. S..... 84
Engineering News-Record..... 2
Equipment Corp. of Am..... 79
Equitable Asphalt Maint. Co..... 6

Fife Equipment Co., Geo. W.... 80
Fischer & Hayes Rope & Steel Co. 80
Forsythe Bros..... 84
Fuller & McClintock..... 96

General Electric Co..... 89
General Motors Truck Co..... 99
George & Co., Inc., E..... 84
Giles & Ransome..... 85
Glaeser, Frederick..... 96
Good Roads Machinery Co..... 24
Good Roads Supply Co..... 82
Graves Machinery Co..... 79
Greisen-Matthael Co..... 80
Gulick-Henderson Co..... 96

Halloran-McLean Tractor Co... 86
Hansen, A. E..... 96
Harris, R. L..... 86
Hazard Mfg. Co..... 88
Hazen, Whipple & Fuller..... 96
Heil Co., The..... 37
Hersey Manufacturing Co..... 92
Higgins, J. Wallace..... 96
Hill & Ferguson..... 97
Hillsman Co., G. E..... 80
Hobbs, L. F..... 86
Hoisting Engine Sales Co..... 84
Holt Manufacturing Co..... 22
Houston, J. C..... 84
Hubbard-Floyd Co., Inc..... 84
Hunter Machy. Co..... 87
Hyland Co., R. H..... 80

International Motor Co..... 90

Johnson Co., Inc., Geo. A..... 97

Kelker, Gates & De Leuw..... 97
Kelly-Springfield Tire Co..... 90
Keystone Driller Co..... 2
King Mfg. Co..... 89
Kinney Mfg. Co..... 26
Knickerbocker Co., The..... 18
Koehring Co..... 77
Koppel Indus. Car & Equip. Co. 12
Kuhn, Frank J..... 82
Kurman Brick & Equip. Co..... 80

Lane Co., T. J..... 85
Light Railway Equipment Co... 20
Littleford Bros..... 90
Lynchburg Foundry Co..... 22

Martin Machinery Co., E. A.... 83
McClure Green Engr. Co..... 97
McGraw-Hill Co..... 2
McKiernan-Terry Drill Co..... 12
Menge Pump & Machy. Co..... 81
Meyer Co., Henry H..... 81
Mills Contractors Equip. Co.... 86
Mueller Mfg. Co., H..... 92

National Meter Co..... 94
National Steel Fabric Co..... 36
Nat'l Water Main Cleaning Co. 93
Neptune Meter Co..... 95
Newport Culvert Co..... 4
Nixon Co., Robt. R..... 86
Nordberg Manufacturing Co.... 88
Northern Fire Apparatus Co.... 94

Olsen, Olek..... 81
Owen Bucket Co..... 6

Pawling & Harnischfeger Co.... 14
Pease Laboratories, Inc..... 97
Peerless Iron Co..... 87
Pennsylvania Cement Co..... 75
Pioneer Asphalt Co..... 22
Pitometer Co..... 91
Pittsburgh Meter Co..... 94
Pollock, C. D..... 97
Porter Co., H. K..... 20
Potter, Alexander..... 97
Potts, Clyde..... 97

Ransome Concrete Machy. Co.. 38
Raymer Equipment Co..... 82
Robinson, Geo. L..... 97
Rochester Can Co..... 88
Roshalt Co., T. W..... 82
Rossiter Co., Edgar A..... 97

Seelye, Elwyn E..... 97
Servicised Products Co..... 20
Shannon & Co., Jacob J..... 85
Smith, Booth-Usher Co..... 78
Smith & Co., C. E..... 97
Smith Co., Geo. P..... 83
Smith & Sons Mfg. Co..... 18
Snare Corp., Frederick..... 96
Southern State Machinery Co... 78
Standard Oil Co. of Indiana..... 12
Steinman, Dr. D. B..... 97
Sykes Company..... 85

Terry & Tench Co., The..... 96
Terry Mfg. Co..... 20
Thew Shovel Co..... 30
Tripp, B. Ashburton..... 97
Truscon Steel Co..... 18
Tucker Co., Geo. G..... 80
Turner Co., C..... 86
Turner Co., J. D..... 78

Union Metal Mfg. Co..... 89
Universal Audit Co..... 96
Urdi Co., G..... 97

Vermeule, Cornelius C..... 97

Wallace Equipment Co..... 82
Wallace & Tiernan Co., Inc..... 34
Ward Co., Lee T..... 85
Waring-Underwood Co..... 6
Weller Mfg. Co..... 28
Western Wood Pipe Pub. Bureau.. 93
Weiss, B. M..... 87
Wettlaufer Bros..... 82
Whayne Supply Co., R. C..... 81
Whinery, S. B..... 84
White Co., The..... 90
White, Gilbert C..... 97
Winther Motors, Inc..... 8

Yancey Bros..... 79
Young & Vann Supply Co..... 78

Ziegler & Co., Inc., Wm. H..... 82
Ziegler Machy. Co., Geo. W..... 86

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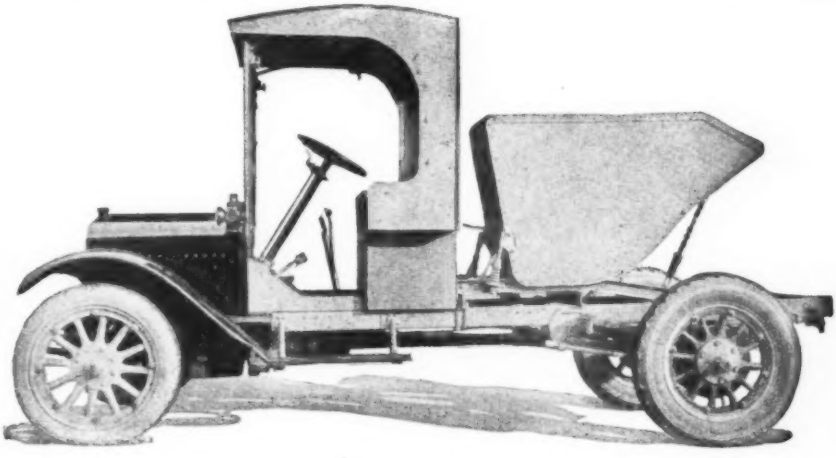

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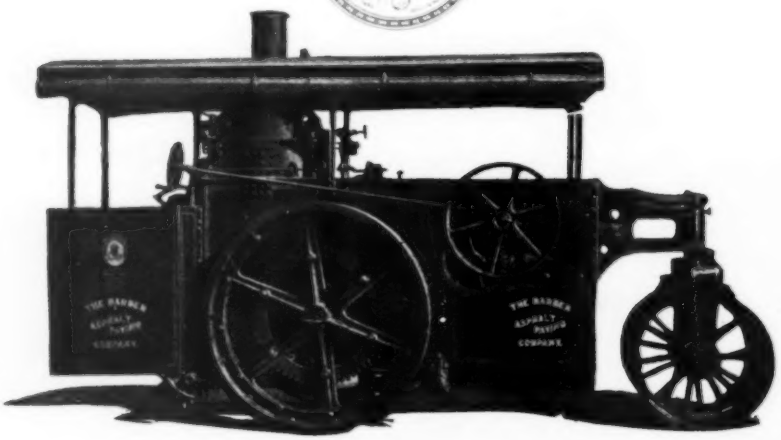

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